Performance and Results of Test of Uniflow Engine—and
Regular Departments Devoted to Operating Practice and Central Station Management

Electrical World

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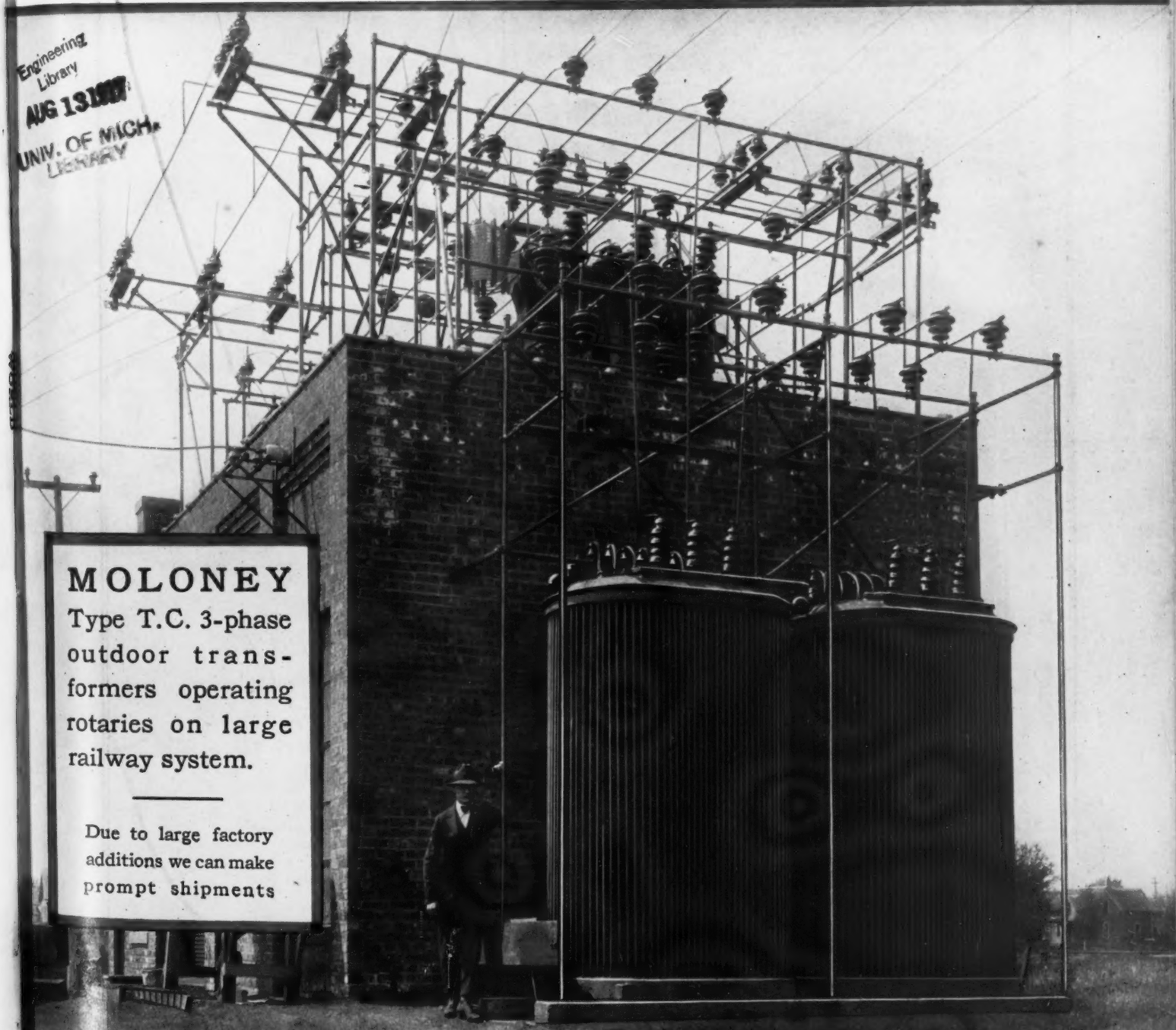

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Converting Energy Into Profits

CONVERTING electrical energy into real profits in the income account is a man's size job these days. More than one public utility company has had some entries in recent months which have been unmistakenly and uncomfortably scarlet in color. There is no disguising the fact that the central station must earn money to live; it cannot just pull through and meet its obligation to give good service to the public, it cannot live from hand to mouth and preserve its credit. Gross business it has in plenty, but a reasonable percentage of the turnover is the fair and earned return of the security holders. The margin of safety above this means too much to the property, too much to the community, to be treated lightly.

There was never a time when it was more important to maintain a good financial showing than in this year of uncertainty. The community is growing; the property has to grow, not with the community, but in advance of the community. The central station keystone is that when the community wants service service it shall have. Of course, the local community stands aside now for the national exigency, but it is still undebatable that the central station enjoys rights of a local monopoly; it is protected and it accepts an obligation which it cannot surrender. In fulfilling this obligation it has to go usually far afield from its own community, it accepts another burden which has also moral and legal angles. Its foremost obligation may be to serve the public, its next is undoubtedly to guard the assets of those whose investment makes it possible to serve. And its only way of guarding the assets is so to manage that they shall earn a return. Service good, assets safe, return fair is the standard.

The reason why all of this has new importance is that in a time when it is harder to work profits out the demands upon the companies, both of the day and the future, are greater than ever before. Production must be stimulated. When consumption catches up with production the logical reply is greater production. But greater production is not a matter of ordering a suit of clothes from a bolt of cloth. It is a question of planning farther ahead than the electrical industry has ever had to look before. To-day in turbines of some sizes it means an order for 1919 or 1920 delivery.

Gross business alone is never the criterion set up by the bankers who guard the purse strings of the investing public. The country is full of concerns which show volume of gross business, imposing totals of actual and book assets, but a balance on the wrong side of the ledger. When European nations sent their first orders to this side of the Atlantic in 1914 and 1915 a war order was looked upon as a sure thing in Wall Street. It was not always that, it was sometimes a liability. The economic requirement of central station operation is adequate net revenue. Its standing as a borrower cannot be held inviolate without that. Its necessary provision for the future cannot be made without it.

Economy in Meter Reading

WHEN one considers the ever-increasing amount of clerical work which accumulates in the office of every central station he instinctively wonders how much of it is absolutely necessary. A certain minimum amount of bookkeeping is very obviously required. Other additional amounts are demanded by the necessity of classifying information and providing proper facilities for the growth of the business, but over and above all these it seems extremely likely that no inconsiderable mass of clerical work is due to blind following of perhaps unwise precedents. The matter of reading meters and of billing in central station practice is one which deserves rather close attention, particularly with reference to the overhead charges involved in the process.

A question that often arises is concerned with the frequency of meter reading and consequent billing as a factor in costs. To read a customer's meter and send the results from the office costs a certain definite amount which can be reckoned up without any particular difficulty. In certain classes of business and in some communities this overhead charge may be a material fraction of the monthly bill. At what point should a just balance be struck between this cost, the interest on the customer's money brought quickly to hand, and the moral risk involved in less frequent meter readings? We have a suspicion that in the current practice of some companies the balance is on the wrong side and that real efficiency demands less frequent readings and balancings than are now customary. In fact, some companies have already found this to be the case and are moving toward measures of reform. The question is an individual one which must be settled on its own merits by every central station manager. The gains to be made by paying a certain amount for the privilege of quicker collections is a comparatively easy thing to reckon. The possibility of bad bills involved by too infrequent meter readings cannot be reckoned directly, but only on the basis of experience with the consumers. One wise old manager remarked not long ago that the average customer was more honest and more inclined to play fairly with the company than was generally supposed. Unquestionably, infre-

quent meter readings may cause some small accounts to be lost altogether, but if the lessened meter and billing charges on the average tend to a favorable balance sheet the moral risk may perhaps be forgotten as it is in many another business. At all events, the subject is one which deserves more thorough consideration than it has generally had, and we trust that our readers who have experimented along this line will give their fellows the benefit of their experience. In these days of increasing costs every means of keeping down unnecessary expense deserves prompt and thorough study.

Federal Aid for Vocational Education

THE Carnegie Foundation for the Advancement of Teaching, which is always prosecuting inquiries in American teaching, has recently published its Bulletin No. 10, on the subject of federal aid for vocational education in general, and on the history of agricultural college federal grants in particular. The historical material presented indicates that numerous attempts to establish agricultural colleges by federal aid have been made during the last hundred years. The most successful effort culminated in the Morrill bill for land-grant colleges, in 1862. The original plans and purposes of these federally endowed institutions seem to have been vague. They appear to have grown up in obedience to individual management, following the lead of existing customs, rather than under a definitely assigned plan. Only in the last twenty years have the agricultural colleges been able to persuade American farmers that the subjects taught had practical value on the farm.

Looking back on the historical picture presented by the bulletin, it is no wonder that events had a trend that way. Agriculture is an industry of enormous and fundamental importance to every nation. It is extremely ancient and intensely complex. There is immense opportunity for science to improve it; but so many factors enter into agricultural production that the influences of scientific knowledge and investigation can only reveal themselves gradually. Not until it is clear that scientifically trained farmers beat rule-of-thumb-trained farmers can there be an economic demand for the agricultural college graduates. In the absence of an economic demand, it is unreasonable to expect a call for scientific farm education. When the demand has once manifested itself federal endowment will not be indispensable. The states and towns will supply the need.

The bulletin goes on to show the danger that besets the path of recent federal aid for other kinds of vocational education, under the law of 1917. The act provides for federal expenditures on trade and industrial teaching, increasing from $1,500,000 in 1918 to $7,000,000 in 1926 and subsequent years. There are two separate questions involved here. One is the propriety of applying federal money and administration to industries in the jurisdiction of the several states. The other is the expediency of applying taxes to the support of vocational schools without a clearly defined plan and program. In regard to the latter question there is enormous need for technical and vocational training of youths who have the ambition to be foremen in industry. For every engineer who is competent to plan and supervise the construction of plant there is need for, say, twenty foremen, to direct perhaps three hundred workmen, in the industrial work of the plant. This need exists not merely in one or two industries, but in a large number of industries. The demand for scientifically trained workmen cannot be created by fiat. It can only come economically, after the scientifically trained men shall have proved that they can outdo the rule-of-thumb-trained men. Once that proposition is clearly established in each industry, federal support will no longer be a necessity.

As to the former question, there is of course always the danger, in a country like ours, of invoking federal taxes for state needs and of creating burdensome unnecessary interference with state or local administration. The hope for checking waste in such matters is to make the federal income tax apply in small measure to small incomes, whereby the average man comes to feel that federal taxation affects him personally in appreciable degree. If the federal funds raised succeed in establishing, economically and manifestly, the industrial utility of scientifically trained workmen, the money will be well expended.

Tests of a Uniflow Engine

OUR readers will be interested in the efficiency test of a uniflow engine reported in another column. The uniflow type of reciprocating engine is especially designed to maintain a steady temperature gradient in the cylinder and to operate with low constant losses, and by means of an unusually simple valve gear, over a considerable range of load. The test before us is specially striking because it was made on an engine which had been working for many months in a steel mill. It was a single-cylinder machine directly connected to a 200-kw. generator and operating at 200 r.p.m. with steam pressure between 135 lb. and 150 lb. per sq. in. (9.49 kg. per sq. cm. and 10.5 kg. per sq. cm.). The vacuum was not particularly good, only 26 in. (66 cm.), and the running conditions for efficiency none of the best. Considering all these conditions, the results reached were highly satisfactory for a simple condensing engine working over a wide range of power. Particularly noteworthy is the exceptionally uniform efficiency obtained through a range running from quarter load to one and a quarter times full load. The variation of efficiency between these limits was approximately 10 per cent. The average consumption of dry steam per indicated horsepower at full load was down to the very creditable figure of 15 lb. (6.8 kg.), and comparing this result with that obtained in shop tests it is apparent that the working of the engine at the last was perhaps even a little better than before it had been put through its forced run for sixteen months, giving the equivalent of two and a half years' operation on the ordinary ten-hour-a-day basis. The results show

very plainly that the development of new ideas in engine construction may well prove a winning game, despite the common belief that the reciprocating engine has been pushed to about its ultimate development.

Transmission-Line Charging Currents

IN LONG-DISTANCE power-transmission three-phase systems the working voltage must necessarily be high in order to keep the cost of the conductors within proper economic limits. Consequently the charging current in amperes on each line may be considerable, with all the loads thrown off, even although the capacitance of each kilometer, to neutral or zero potential, may be less than one-hundredth of a microfarad. These charging currents represent a very considerable apparent power in kilovolt-amperes, although the active power at no load may be very small. In some cases the change in voltage and in current at the generator station between no load and full load may be comparatively small, the change being met by the power factor of the system. The apparent power may be nearly the same throughout, but the active power will change from a small to a large quantity.

In the ideal case of three symmetrical working aerial-line wires supported on poles or towers, with no other conductors parallel thereto, such as ground wires or telephone wires, the linear capacitance of each wire of the system is easily found from textbooks or tables, and the linear charging current is the product of the linear capacitance, the star voltage and the impressed alternating angular velocity. If, however, the line wires are dissymmetrically arranged, or if there are other parallel wires in their vicinity, or again if one of the working wires is grounded, then the linear capacitances and the charging currents of the system are no longer easily found. In many practical cases the computation of these quantities becomes very complicated, especially when a number of wires are carried side by side on the same poles. The laws governing such cases were first enunciated by Maxwell and were extended by Heaviside.

The article by R. H. Marvin, the first part of which we publish this week, discusses the Maxwell method in detail. It has the merit of dealing with specific cases in which the observed actual charging currents are compared with the computed values. It appears that in nearly all practical cases the observed values somewhat exceed the computed values. In fact, the computed values are limiting minima, and the actual conditions always tend to exceed them. The formulas of Maxwell only consider the linear capacitance between wires or their images in air. In addition, there is the capacitance of the insulators themselves and the capacitance between the wires and the poles or towers considered as conducting supports. When there are many parallel wires on the poles the corrections for these extra capacitances of supports may be negligible, but in the opposite case the corrections may be appreciable. Mr. Marvin's article is useful in calling attention to these discrepancies.

Upkeep of Industrial Lighting Systems

ANOTHER of Professor Clewell's suggestive papers will be welcomed by those in charge of industrial lighting plants. It is well known to illuminating engineers that many an installation thoroughly satisfactory at first proves in the long run inefficient. Part of the difference may be charged up perhaps to the psychological factor which makes the human mind discontented with its wonted conditions, but there is in addition a very real depreciation in service due to lack of care and the inevitable incidence of dirt. It is this question of upkeep which Professor Clewell particularly discusses. According to the data which he has accumulated on a typical factory case it pays, from the standpoint of efficiency versus cost of upkeep, to clean lamps and reflectors about every two weeks. Where dirt is more than usually severe the interval should be shorter than this; where less severe it may be somewhat longer. From a practical standpoint the fact which stands out conspicuously is that if the clean lamp in its reflector is operating on the basis of 1 watt per candle as short a period as three weeks without cleaning may reduce the lamp to a rating of about 2 watts per candle. If it were suggested to the factory manager at the present time to use lamps having so low a rating he would be astonished and incensed; yet from ignorance of the facts losses of this magnitude may be going on right under his nose all the year round. The whole matter is gone into by Professor Clewell on a careful and scientific basis which ought to leave no more excuse for the bad maintenance of a good installation than there is for an installation in itself positively bad.

The Coming Issues

NOW that the lighting companies are convinced that the business is largely one of service, the question of the proper location of the offices is of considerable importance. Customers do not care to go into the manufacturing part of the city where the plant is located to pay their bills. Nor do they care to walk to one end of the town. Besides, if the sale of appliances, the orders for service, etc., are to come in freely, the office must be placed in the "path of least resistance." An analysis of some of the best opinions on this topic will be found in the coming issue. As a bridge between the industrial lighting series by Prof. C. E. Clewell and the municipal lighting series by J. R. Cravath, which will start in the Sept. 1 issue, there will be an article next week on a novel method for lighting an underground passageway whereby the effect is one of sunlight. A third article will describe the success experienced in St. Louis in selling ranges. These will all be in addition to the regular departments devoted to operating practice, commercial service and to the news, including that of the trade.

Operation and Upkeep of Factory Lighting Systems

Value of Upkeep of Lighting Systems—Table of Utilization Efficiencies—Notes on Systematic Maintenance—Items in the Operation of Various Lamps That Determine Operating Charges

BY C. E. CLEWELL

Assistant Professor of Electrical Engineering, University of Pennsylvania

SUMMARY.—This article contains a discussion of some of the important phases of practical operation and upkeep in the factory lighting equipment. At the outset it is suggested that an allowance be made in every new system for the natural deterioration which must be expected owing to gradual decreases in the candlepower of lamps with time of service, to accumulations of dirt on lamps and reflectors, and to the gradual decrease in the reflecting efficiency of metal or glass reflector surfaces and of ceilings and walls. Mention is made of the value to a plant of the establishment of a regular maintenance division for attention to lamp renewals and reflector cleaning, and in this connection reference is had to the magnitude of the illumination losses that result if this kind of work is neglected. Methods of simplifying access to overhead lamps for renewal and cleaning are explained, and precautions to be taken in the use of glass reflectors with overhead lamps so as to reduce the accident risk to workmen beneath in case a reflector breaks are suggested. The author explains why so many well-designed lighting systems which are entirely satisfactory at the start soon become totally inadequate through the neglect of the various points brought out in this article.

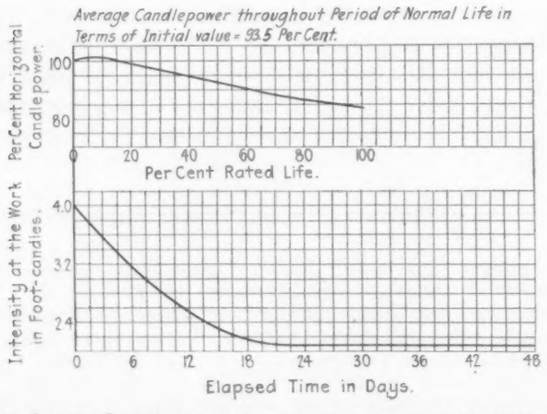
THE utilization efficiency of a lighting system is defined as the ratio of the total luminous flux effective on a reference plane (in factory lighting, a plane passing through the work) to the total luminous flux generated by the bare lamps of the systems. This means that a system with a utilization efficiency of 50 per cent directs one-half of the generated light flux to the work. The other half is lost as far as the working surfaces are concerned, being absorbed by the reflector, possibly by dirt on the lamps and reflectors, and by walls and ceiling and other surrounding objects.

INITIAL AND AVERAGE PERFORMANCE OF SYSTEM

The accompanying table[1] gives values of this factor for systems of tungsten lamps, which are calculated on a basis of the simple relation shown in the equation:

$$E = \frac{L \times K}{A \times 100}, \text{ or } \qquad K = \frac{E \times A \times 100}{L},$$

where E is the average measured intensity of the illumination on the working plane, L the total lumens per lamp, K the utilization efficiency expressed as per cent, and A the average floor area in square feet illuminated by each lamp.



FIGS. 1 AND 2—HORIZONTAL CANDLEPOWER PERFORMANCE OF MAZDA LAMP THROUGHOUT NATURAL LIFE; PERFORMANCE CURVE OF LAMP AND PRISMATIC GLASS REFLECTOR SHOWING EFFECT OF DIRT

[1]As given in Bulletin 20 of the National Lamp Works of the General Electric Company.

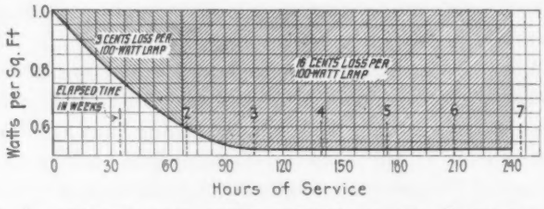


FIG. 3—PERFORMANCE CURVE SHOWN IN FIG. 2 WITH NEW CO-ORDINATES TO SHOW LOSSES IN WATT-HOURS DUE TO DIRT ACCUMULATIONS

The values of K as usually published represent the conditions of the system when first installed; that is, when the lamps are new and when both lamps and reflectors are clean. It should be noted also that since K depends to some extent on the color of walls and ceiling, the conditions of the surroundings should be known before this constant is selected for use in a practical case. The table shows in a striking manner the higher values of K for the larger installations than for those cases where only a few lamps are used to illuminate a small area.

The fact that the value of K may be from 30 to 60 per cent greater with white walls than for dark surroundings in some installations and for some types of reflectors shows at once that if a system of lamps is installed in a new building the gradual deterioration in the color of walls and ceiling, due to accumulations of dust and dirt, will reduce the effectiveness of the lamps with time of service. To the factor of absorption by surroundings there must be added the material, although not very large, decline in the candlepower of a lamp below its initial value, as shown for tungsten lamps by the curve in Fig. 1. This decrease in candlepower, it will be noted from the curve, is such for this

TABLE OF UTILIZATION EFFICIENCIES*

Type of Installation	Reflector	
	Enameled-Steel Dome	Enameled Steel or Pyro Glass Bowl
One unit	28	24
One row of five units	42	36
Two rows of two units	48	41
Two rows of three units	52	44
Three rows of three units	56	47
Three rows of four units	60	49
Four rows of four units	63	51
Four rows of eight units	67	54
Eight rows of eight units	71	57

*Units spaced 1.5 to 1.6 times their height above the working surface.

type of lamp as to reduce the candlepower about 15 per cent below its initial value at the end of its natural life.

The other very important item of deterioration is that due to accumulations of dirt on the lamps and reflectors themselves. The curve in Fig. 2 is plotted from actual test observations made under factory conditions, and in this case it is evident that the decrease in candlepower is likely to be very rapid under typical shop surroundings. The curve shows in this case a fall in the intensity on the working plane of nearly 50 per cent in twenty-one days. These items all go to lower the value of the utilization efficiency throughout the regular performance of any factory lighting system, and hence it is very desirable to allow for these conditions in the original calculation of the lamps necessary to supply sufficient illumination for any particular shop work.

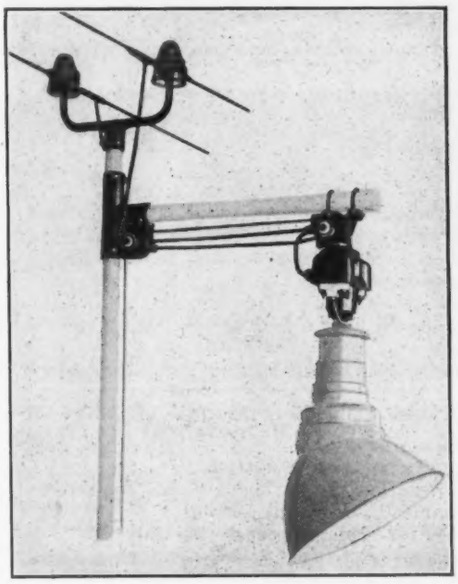


FIG. 4—THOMPSON AUTOMATIC DISCONNECTING HANGER, STANDARD SEMI-INCLOSED TYPE FOR INDOOR OR OUTDOOR SERVICE

LOSSES FROM LACK OF FREQUENT CLEANING

In Fig. 3 the curve of Fig. 2 is plotted with a new set of co-ordinates, so as to show the order of magnitude of the losses which may occur from dirt on lamps and reflectors. On the basis of 4 effective lumens per watt, the maximum ordinate of the curve, to the left, is made equal to 1 watt (per square foot) on this new scale, and on the assumption that the lamps burn five hours a day the new scale of abscissas is such that thirty hours are equivalent to six days in Fig. 2. The area of the shaded portion of the curve, which represents the losses in intensity due to dirt, is thus directly equal to watt-hours (per square foot).

In Fig. 3 the amount of the shaded area, beginning at the extreme left, which corresponds to 3 cents has been calculated on a basis of 2 cents per kilowatt-hour for energy and maintenance and for a single 100-watt tungsten lamp. Where the loss of light represents an expenditure for energy and maintenance equal to 3 cents, as shown, this loss is approximately equal to a fair value for the cost of cleaning the lamp and reflector. This point occurs at the end of about fourteen days. At the end of seven weeks, if the unit is not cleaned, the loss per 100-watt lamp amounts to about 19 cents. Obviously, if the energy rate is greater, this loss will be correspondingly greater.

It is interesting to note that when the light has fallen to a value of about one-half its original value—that is, at the end of three weeks—the lamps are operating as the equivalent of a system of units which produce about 2 effective lumens per watt, and if the lamps are rated at, say, 1 watt per candle, they are equivalent after three weeks to lamps with a rating of about 2 watts per candle. Hence any system which deteriorates according to this curve after three weeks of service is costing nearly double the amount for light which is necessary. Furthermore, the management could afford to clean its lamps and reflectors at intervals of about two weeks, because after two weeks the combined cost of cleaning plus the loss in light since the previous cleaning will exceed the value of these two items at the two-week point.

Incidentally, the system, if made up of, say, 1000 tungsten 100-watt lamps and if operating as shown in the curve of Fig. 2, represents, after three weeks, a loss of something like $5 a day, or roughly $1,500 per annum, with the combined energy and maintenance charge equal to 2 cents per kilowatt-hour. In other words, the lighting for a floor area of about 100,000 sq. ft. (9290 sq. m.), or about 300 ft. (91.4 m.) on a side, would represent a loss of nearly $1,500 per annum if the lamps and reflectors were not cleaned at sufficiently short intervals. Of course, even if cleaning is scheduled for every two weeks, this loss, though considerably reduced, is not entirely obviated, since the average intensity during two weeks will be somewhat less than the initial value.

NOTES ON SYSTEMATIC MAINTENANCE

A scheme which has worked out successfully is to assign the work of lamp upkeep to a regular lamp department, a good plan in such an event being to have every lamp and reflector inspected each day, and on the basis of this inspection to have all burned-out lamps renewed on the same day and to see to it that all inci-

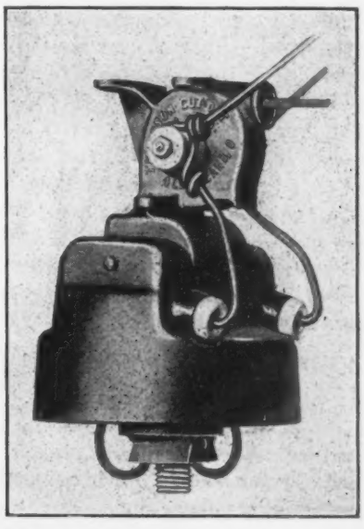


FIG. 5—DEEP CANOPY OR STORM-JACKET TYPE OF THOMPSON HANGER WITH PROTECTION AGAINST SLEET FOR YARD SERVICE

dental repairs on switches, sockets, mercury-vapor and arc lamps are promptly made. In addition to the success of this scheme in maintaining all lamps in good condition from day to day, such an orderly procedure makes it possible to keep a record of all supplies used for this work, and on a basis of this record a monthly and an annual summary of the upkeep cost can be made. This has the obvious advantage of affording a check on whether this maintenance work is being properly done.

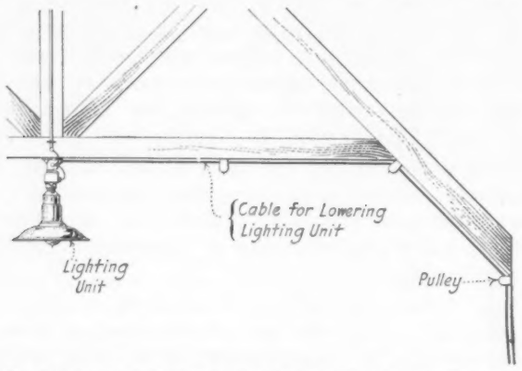


FIG. 6—SCHEME SUGGESTED FOR THE USE OF AUTOMATIC DISCONNECTING HANGERS FOR INTERIOR WORK WITH MAZDA OR OTHER TYPES OF LAMPS

The use of the overhead system of lamps has the advantage of placing the lamps out of the reach of the workmen, and theft of lamps is thus reduced. On the other hand, however, the work of renewing lamps and getting at reflectors for cleaning is somewhat complicated by the added difficulty experienced by the maintenance men in reaching the units. For mounting heights of 12 ft. (3.7 m.) a stepladder may be used, and even for 16 ft. (4.9 m.) with open roof trusses a regular ladder may be employed. With lamps at a greater height the difficulty increases considerably.

For the larger units some form of automatic disconnecting hanger[2] is useful, as indicated by Figs. 4 and 5. Fig. 6 is a suggestion of how such a hanger may be employed with pulleys where the lamps are mounted at central points in the aisles. The tops of overhead traveling cranes are also a favorite means for getting at high lamps, although this is a dangerous procedure and one to be discouraged. Two maintenance men are shown in Fig. 7, the one to the right standing on an adjoining mezzanine floor and the other exchanging a reflector for cleaning, from the top of a crane which runs over an aisle 20 ft. (6.1 m.) below. The general conditions shown by this view, such as the proximity of crane trolley wires, low girders, etc., indicate the danger of such a method.

ORDERLY WORK RECOMMENDED

There are, of course, some shops where the number of lamps is so small as to make a separate well-organized maintenance division for lighting out of the question. For the larger shops, however, such a division becomes increasingly important. For the successful conduct of the work it is recommended that the stock room be planned in such a manner that all supplies will be kept in an orderly fashion and that a scheme be devised for checking supplies so that the somewhat irregular calls for renewals and repair parts may be recorded systematically. Under one system in use each

[2]Figs. 4, 5 and 6 are shown by courtesy of A. J. Thompson, president Thompson Electric Company.

ITEMS IN THE OPERATION OF MAZDA LAMPS

Fixed Charges:
- Interest on total investment.
- Depreciation on wiring and on non-renewal part of equipment, i.e., except lamps.
- Labor for cleaning lamps and reflectors (monthly).[4]

Maintenance:
- Lamp renewals.
- Repairs on sockets, switches, replacing fuses, etc.

Energy:
- Energy cost at given rate per kilowatt-hour.

ITEMS IN THE OPERATION OF MERCURY-VAPOR LAMPS

Fixed Charges:
- Interest on total investment.
- Depreciation on wiring and on non-renewal part of equipment, i.e., except tubes.
- Labor for cleaning tubes and reflectors (monthly).

Maintenance:
- Tube renewals.
- Repairs on lamps, switches, replacing fuses, etc.

Energy:
- Energy cost at given rate per kilowatt-hour.

ITEMS IN THE OPERATION OF ARC LAMPS

Fixed Charges:
- Interest on total investment.
- Depreciation on wiring and on non-renewal part of equipment, i.e., except carbons.
- Labor for cleaning globes (monthly).[5]

Maintenance:
- Lamp trimming.[5]
- Repairs on switches, lamps, replacing fuses, etc.

Energy:
- Energy cost at given rate per kilowatt-hour.[6]

lamp trimmer has a numbered hook for his box of new carbons, and beneath this there is a pan for all the old pieces, so that the foreman can ascertain the point

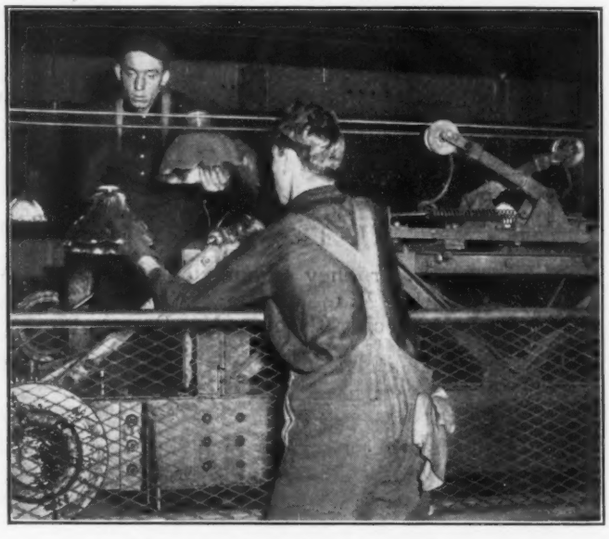


FIG. 7—DANGER IN USE OF CRANE AND MEZZANINE FLOOR IN CHANGING REFLECTORS FOR CLEANING

at which trimming is done and know whether waste is taking place.

Where glass reflectors are used with lamps overhead,

[4]Note that the labor charge for lamp and reflector cleaning is placed under fixed charges. In doing so it is assumed that the equipment will be cleaned at regular intervals (for example, once a month) independently of the number of hours the lamps burn.

[5]If globe cleaning is performed at the time of trimming the lamps, it then becomes a function of the number of hours which the lamps burn and should be included as one of the items under maintenance.

[6]In a subsequent article these maintenance items will be the subject for a further analysis.

they should be protected, for the safety of workmen beneath, as shown in Fig. 8, which gives an idea of how a wire-mesh screen may be woven about each reflector in an inexpensive but effective way. This wire screen is attached to the shade holder, and if the glass is broken the wire retains the pieces of glass as shown, thus preventing them from falling on the heads of workmen who may be below.[8]

The prevention of lamp theft is a troublesome item to

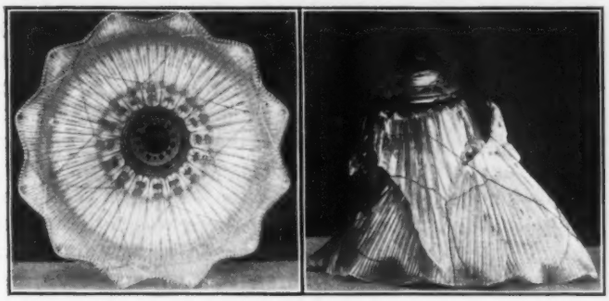


FIG. 8—MESH-WIRE SCREEN WOVEN ABOUT GLASS REFLECTOR; ACTION OF WIRE MESH IN RETAINING PIECES OF BROKEN GLASS

deal with in a large plant. Various lock sockets have been devised, but in general their use impedes the work of maintenance to such an extent when renewals are made or when reflectors are exchanged for cleaning that they become a nuisance rather than a help. Again, if a disconnecting hanger is employed for individual units, so that the maintenance man may lower the lamps from high points to a position within his reach from the floor, unprincipled employees may, with equal ease, lower the lamps and remove them.

The data at the top of the opposite page show the various items associated with factory lighting operation and upkeep, and also show how these items may be grouped under the headings of fixed charges, maintenance and energy. The total annual operating charges are found by adding the items under these three heads in any practical case.

BOSTON COMPANY URGES ADEQUATE RESERVE PLANT

Recommends Emergency Connections and at Least One Extra Unit Rated as High as Largest Unit in Plant—Forcing Turbines Not Practicable

Experience and tests have shown the Boston Edison company that it is necessary to have ample reserve capacity rather than to depend on the overload capacity of turbines, according to testimony given before the Massachusetts Gas & Electric Commission by L. L. Elden, electrical superintendent of the company. The benefit of emergency connections was also emphasized, it being pointed out that the Interborough Rapid Transit Company of New York depends on the connections with the New York Edison Company to supply any deficiency in power. The transit company is connected with the Edison Electric Illuminating Company of Brooklyn for the same reason.

The necessity for adequate reserve was especially emphasized lately when the largest unit (35,000 kw.) and two smaller units (7500 kw. each) in the Philadelphia plant became inoperative during a peak load of 135,000 kw. Street-lighting service had to be discontinued for one night and part of another. It was also brought out in the testimony that the Cleveland municipal plant, which has no reserve equipment, gives such unreliable service that consumers now connected with the private electric service company's plant will not consider municipal plant service.

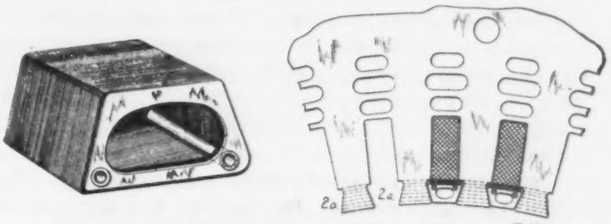
For many years the Boston company has felt that reserve capacity equivalent to the largest unit on the system is sufficient, though it should never be less. The risks of the electric service business have grown so, however, with the increase in size of apparatus and with the increase of operating voltage that this company no longer feels safe with one extra unit. Mr. Elden considers that where a company is operating two systems—that is, at two different voltages—a spare unit should be provided for each system.

While turbo-generators may develop ratings higher than normal for short periods with normal steam pressure and vacuum, the over-rating should not be depended on for reserve capacity as it is limited by the size of the condenser outlet, the ability of the pumps to remove the condensate and the condition of the turbine blades and condenser tubes. When variable-speed condenser auxiliaries are used, operating at over-rating is more likely to be possible. In practically every test the Boston company has made to operate at over-rating, it has been successful only for five to ten minutes; then the condensers fill up with water because the pumps are unable to dispose of the condensate fast enough. As a result the vacuum drops or is lost entirely. Furthermore, these over-ratings are obtained only at 100 per cent power factor, whereas the usual operating power factor is never so high.

SHORT-CIRCUIT REACTANCE WEDGES FOR DYNAMOS

A Method That Permits of Ready and Rapid Winding of the Coils and Maintains Them Securely in Position

Prof. A. B. Field proposes in patent No. 1,227,414 the use of laminated wedges of trapezoidal form so as to provide a characteristic for dynamo-electric machines ordinarily subject to dangerous short-circuit stresses. The wedge for the armature slots is laminated and substantially trapezoidal in form, having large flat surfaces and a longitudinal aperture therethrough for



TRAPEZOIDAL WEDGE FOR DYNAMO-ELECTRIC MACHINE

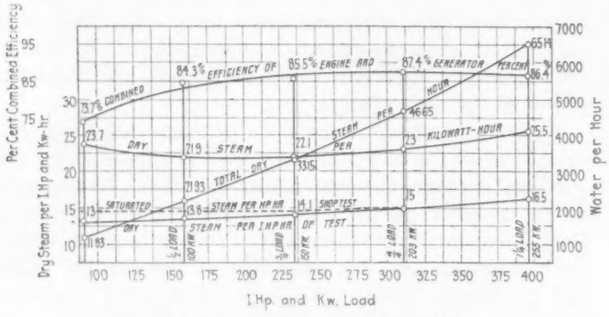
purposes of ventilation. It will be noted from the accompanying illustrations that the coils are thus disposed at an appreciable distance from the machine air gap proper, thereby considerably increasing the effective air gap and internal reactance of the machine and excluding the working conductors for the cross-flux in the tops of the slots.

[8]Fig. 8 is shown through the courtesy of the Westinghouse Electric & Manufacturing Company. The reflector shown is a case of breakage in actual service.

PERFORMANCE OF UNIFLOW ENGINE IN STEEL MILL

High Economy Shown Even Under Light and Overload Conditions—Valves Found in Good Condition After Nearly 10,000 Hours' Operation

Present prices of material and labor make it so essential to consider every means of increasing plant economy and securing the maximum benefit out of the invested money that the advantages of the uniflow engines should not be overlooked. This type of prime mover should have special consideration where units of 500 kw. or smaller are to be used, when the load is liable to fluctuate considerably, and when condensing and non-condensing operation may be alternately required.



TEST CURVE OF UNIFLOW ENGINE

After sixteen months' service the uniflow engine installed in the steel plant of the L. F. Shoemaker Company, Pottstown, Pa., was tested by the engineers of the steel company and showed very high economy (see accompanying data) especially at small loads. This unit had been operated six days per week and twenty-two hours per day during the greater part of the time, or the equivalent of two and one-half years' service with ten-hour-day operation. The very high economy at small loads is worthy of particular attention, especially when it is referred to on the basis of steam consumption per kilowatt-hour. A particularly interesting feature of the test data, aside from the maintained economy, is the improved economy obtained after the equivalent of two and one-half years based on a ten-hour day, as indicated by the dotted steam-consumption curve. This curve shows the results of a test of this particular engine on the builder's test block previous to shipment.

Conditions Under Which Tests Were Conducted

The test was made with conditions not so ideal as those that prevailed during the field test after installation, as the load was absorbed by a prony brake which made it almost impossible to carry the loads with the same uniform steadiness as with the electrical load during the field test.

Just previous to the test, which was made at quarter, half, three-quarters, full and one and a quarter times full load, indicator cards were taken at different loads and minute adjustments were made on the valve and reach rods to obtain proper and uniform steam distribution. This was done to compensate for adjustments in the valve-gear rocker-arm boxes which had been made during the operation of the engine while in service. Tests of the valves prior to making the adjustments and immediately after the completion of the test showed them to be absolutely steam-tight.

During the entire test indicator cards and electrical readings were taken every two and one-half minutes, and all gages and temperature readings were taken every five minutes. The vacuum was determined by a mercury column connected to the exhaust line close to the engine cylinder. The pressure-gage indications were checked by thermometer readings. The quality of steam was determined by a Carpenter throttling calorimeter. Crosby outside-spring steam indicators were employed. The voltmeters and ammeters from which the electrical load readings were taken were of a standard make and comparatively new. As they had been recently calibrated they were assumed to be correct during the test. The total steam at all loads was accounted for by condensing the exhaust in a surface condenser and weighing the condensate. As all jacketing steam for the engine cylinder passed through the cylinder with the live-steam supply, there was no trap discharge other than that from the oil separator in the exhaust between the engine and condenser. This discharge was retained, and the total for each load test was weighed and charged against the engine.

Each load was of sufficient duration (extended to one and one-half hours on the heavier loads) to insure accuracy. Owing to the construction of the rheostat used (installed in cooling pond) it was possible to maintain practically uniform load throughout the entire period, so that little or no difference was shown in the mean effective pressure on the indicator cards. With commercially dry saturated steam, supplied from a 200-hp. Badenhausen water-tube boiler, the engine showed the economy given in the accompanying table.

For the first few months the unit was operated non-condensing, during which time the condenser and auxiliaries were being installed. After the installation of the condensing apparatus the automatic by-pass valves furnished with the engine were placed in operation. With these valves the engine may be operated condensing or non-condensing as local conditions require, it being possible to start the engine with or without vacuum.

The by-pass valves do not operate at every stroke of

RESULTS OF TEST ON STEEL MILL UNIFLOW ENGINE

	Load				
	¼	½	¾	Full	1¼
Average steam pressure at throttle valve (lb.)	154.3	152.0	154.4	153.0	155.5
Average vacuum at exhaust nozzle (in.)	26.13	26.0	26.0	26.0	26.0
Average mean effective pressure (lb. per sq. in.)	13.0	22.75	33.82	44.93	57.0
Average indicated hp	90.9	159.0	235.0	311.0	396.0
Average moisture in steam delivered to engine (per cent)	0.2	0.11	0.085	Dry	Dry
Total dry steam consumed by engine per hour (lb.)	1183.0	2193.0	3315.0	4665.0	6514.0
Average dry steam consumption per indicated hp.-hr. (lb.)	13.03	13.8	14.1	15.0	16.44
Prevailing load on generator at switchboard (kw.)	50.0	100.0	150.0	203.0	255.0
Average dry steam consumption per kw.-hr. (lb.)	23.7	21.9	22.1	23.0	25.50
Combined engine and generator efficiency (per cent)	73.7	84.3	85.5	87.4	86.40

the engine during either condensing or non-condensing operation, but only during the change of operating condition. By means of the adjusting screw controlling the tension of the springs they may be made to operate at any desired degree of vacuum from 10 in. or 12 in. (25.4 cm. or 30.5 cm.) up to maximum or perfect vacuum.

The engine which was tested is an Ames-Stumpf uniflow engine having a 19-in. (48.3-cm.) diameter cylinder with 24-in. (59.9-cm.) stroke. The engine is direct-connected with a 200-kw., 250-volt direct-current Crocker-Wheeler generator, which furnishes energy for electric cranes, heavy punches, shears and general motor loads and in addition all energy for the entire lighting system. The load is extremely variable, there being frequent flash-load fluctuations from one-half load to 25 per cent overload. The unit operates at 200 r.p.m. with pressure at the throttle valve ranging from 135 lb. to 150 lb. (9.5 kg. to 10.5 kg. per sq. cm.), with practically uniform vacuum, and is rated at 320 indicated horsepower, with 150 lb. (10.5 kg. per sq. cm.) vacuum, cutting off at one-fifth of the stroke.

Transmission-Line Charging Currents—I

Method of Using Capacity and Potential Coefficients to Determine Charging Currents in Three-Phase Lines—Application of Maxwell's Formulas

BY R. H. MARVIN

WITH the extensive transmission systems now in use the charging currents due to the electrostatic capacity of the conductors are of such magnitude as to be of considerable importance. In the normal operation of the system these currents are approximately balanced. Their value can be calculated with sufficient accuracy by simple and well-known formulas. But frequently one of the conductors becomes connected to the earth through the failure of an insulator or the breaking of the line. With a grounded neutral system this causes a short-circuit. With a non-grounded or isolated system it may be possible to continue to operate, at least temporarily, but the charging currents are much increased and the currents in the different phases are decidedly unbalanced. Then also various forms of arcing-ground suppressors have been devised for the protection of lines, which temporarily ground the system.

The calculation of the charging currents with one conductor grounded is at best somewhat complicated. The height of the conductors above the ground, and the effect of the overhead ground wire, must be taken into account. An attempt is made in this article to give a definite and systematic method of making the calculations. Several examples will be worked out and the results compared with those obtained by actual test. The discussion is limited to three-phase lines as they are used on practically all modern systems. The changes necessary in the formulas to adapt them to two-phase or single-phase lines will be readily apparent.

CALCULATION OF CAPACITY COEFFICIENTS

The capacity of a conductor is defined as its charge when its own potential is unity and that of all surrounding conductors is zero. Considering a system of any number of conductors, which are numbered 1, 2, 3, . . . n, assume the first conductor receives a positive charge $C_{1\cdot1}$ sufficient to raise it to unit potential, and that all the others are meanwhile maintained at zero potential. There must also be an equal and negative charge distributed over the other $(n-1)$ conductors. The negative charge on the second conductor will be called $C_{1\cdot2}$, on the third conductor $C_{1\cdot3}$, on the nth conductor $C_{1\cdot n}$. As the positive and negative charges are equal

$$C_{1\cdot1} + C_{1\cdot2} + C_{1\cdot3} \ldots + C_{1\cdot n} = 0.$$

In a like manner, if the second conductor is raised to a potential of one, all the others being at zero potential,

$$C_{2\cdot2} + C_{2\cdot1} + C_{2\cdot3} \ldots + C_{2\cdot n} = 0.$$

Similar equations exist for the other conductors.

The quantities $C_{1\cdot1}$, $C_{2\cdot2}$, . . . $C_{n\cdot n}$, are coefficients of self-induction, while $C_{1\cdot2}$, $C_{2\cdot3}$, etc., are coefficients of mutual induction. It can be readily shown that the mutual effects are equal, so that $C_{1\cdot2}$ equals $C_{2\cdot1}$, $C_{2\cdot3}$ equals $C_{3\cdot2}$, etc. It should be noted that if the coefficients of self-induction are positive, then all the coefficients of mutual induction are negative. This affords a valuable check on numerical work.

Assuming that the conductors are simultaneously charged to potentials, v_1, v_2, v_3, . . . v_n, the charge q on any conductor is that due to its own potential plus that due to the potentials of all the others. Thus:

$$q_1 = C_{1\cdot1}v_1 + C_{1\cdot2}v_2 + C_{1\cdot3}v_3 \ldots + C_{1\cdot n}v_n,$$
$$q_2 = C_{1\cdot2}v_1 + C_{2\cdot2}v_2 + C_{2\cdot3}v_3 \ldots + C_{2\cdot n}v_n,$$
$$q_n = C_{1\cdot n}v_1 + C_{2\cdot n}v_2 + C_{3\cdot n}v_n \ldots + C_{n\cdot n}v_n.$$

If the capacity coefficients* are known, the charge on any conductor due to any system of potentials can be found. The differential coefficient of the charge with respect to time gives the charging current.

The method which will be given for deriving the capacity coefficients involves the use of potential coefficients, so a brief explanation of these will be given. Assume a system of n insulated conductors, having charges of Q_1, Q_2, Q_3, . . . Q_n, respectively. The potential of conductor No. 1 due to its own charge only may be expressed as $p_{1\cdot1}Q_1$, the potential of conductor No. 2 due to the charge on No. 1 as $p_{1\cdot2}Q_1$. The total potential of each conductor is the sum of all the separate effects. Let V_1, V_2, V_3, . . . V_n, be the resulting potentials of each conductor, then

$$V_1 = p_{1\cdot1}Q_1 + p_{1\cdot2}Q_2 + p_{1\cdot3}Q_3 \ldots + p_{1\cdot n}Q_n.$$
$$V_n = p_{1\cdot n}Q_1 + p_{2\cdot n}Q_2 + p_{3\cdot n}Q_3 \ldots + p_{n\cdot n}Q_n.$$

The quantities $p_{1\cdot1}$, $p_{2\cdot2}$, . . . $p_{n\cdot n}$ are called potential coefficients of self induction, and $p_{1\cdot2}$, $p_{1\cdot3}$, etc., potential coefficients of mutual induction.

To derive the potential coefficients of a transmission line the method of images will be used. That is, the surface of the earth is replaced by an imaginary conductor of the same dimensions as the real conductor,

*For the general theory of capacity coefficients see Clerk Maxwell, "Electricity and Magnetism," Vol. I, and J. H. Jeans, "The Mathematical Theory of Electricity and Magnetism."

but placed as far below the earth's surface as the actual conductor is above it, and having an equal and opposite charge. This reduces the problem of finding the potential at any point between the wire and the earth to that of finding the potential at any point between two parallel wires.

In Fig. 1 let A and B be the sections of two parallel

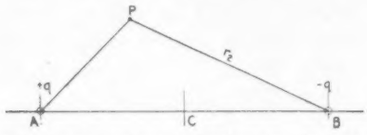


FIG. 1—METHOD OF FINDING POTENTIAL AT ANY POINT BETWEEN WIRE AND EARTH

wires perpendicular to the plane of the paper. The wires are assumed to be so small that they may be regarded as lines. Let the charge on A be $+ q$ absolute electrostatic units per centimeter length, and on B, $- q$ units. Join A and B and let the point C bisect this line. From any point P outside the conductors, draw PA and PB. Let $AC = c$, $AP = r_1$, $BP = r_2$.

The force at any point outside an infinitely long charged wire is $-dV/dr = 2q/r$, where V is the potential of the point in absolute electrostatic units, and r its distance from the center of the wire. Then the difference of potential between P and C due to the charge on A only is

$$V_p' - V_c' = -\int_c^{r_1} \frac{2q}{r} dr = 2q \log_e \frac{c}{r_1}.$$

Similarly the potential at P due to B only is

$$V_p'' - V_c'' = \int_c^{r_2} \frac{2q}{r} dr = -2q \log_e \frac{c}{r_2}$$

The potential v at P due to both charges is the sum of these values. Hence,

$$v = (V_p' - V_c') + (V_p'' - V_c'') = 2q \log_e \frac{r_2}{r_1}$$

in absolute electrostatic units.

The preceding expression consists of two factors—the charge q and $2 \log_e \frac{r_2}{r_1}$. The latter factor, which is the quantity by which the charge is multiplied to give the potential at P, is the potential coefficient of the conductor and its image with respect to P. It is the sum of the potential coefficients of the conductor to the point and the image to the point. If the point P be taken on the surface of the conductor—that is with r_1 equal to the radius of the conductor and r_2 the distance between the center of the conductor and the center of its image—the potential coefficient of the conductor and its image to itself is obtained. If P is taken at the center of an adjacent conductor, the potential coefficient of the conductor and its image to this is obtained.

In this discussion it is assumed that the spacing of the conductors from each other and from the earth is so large compared to their radii that the charge may be considered as being uniformly distributed over the surface of the conductor. With the spacings usual on transmission lines this assumption involves no appreciable error.

COEFFICIENTS FOR CONDUCTORS PARALLEL TO EARTH

The potential and capacity coefficients will now be derived for four parallel cylindrical conductors running parallel to the earth. This condition covers the case of a three-phase line with overhead ground wire. For any smaller number of wires it is only necessary to omit in the determinants the potential coefficients of the missing wires.

For simplicity and convenience the expression for the potential coefficient will be written, $\log \frac{r_2}{r_1}$. The use of common logarithms and the omission of the factor 2 is allowed for in the final calculation of the capacity coefficients by a factor A which also converts the results from absolute electrostatic units per centimeter to farads per kilometer or per mile.

The conductors are numbered 1, 2, 3, 4, and their images 1′, 2′, 3′, 4′. The radii of the conductors are a_1, a_2, a_3, a_4. The distances between the centers of the conductors are represented by (1, 1′), (1, 2), (1, 2′), etc., the two numbers in the parenthesis indicating the conductors between the centers of which the distance is measured. (See Fig. 2.)

No particular units have been specified for the radii of the conductors and their spacing, owing to the fact that these quantities enter into the formulas only as ratios, and therefore any unit of length can be used if the same unit is used for all. This is a great convenience as the dimensions may be taken in either the English or metric systems.

The potential coefficients of each conductor and its image to itself are:

$$P_{1\text{-}1} = \log \frac{(1, 1')}{a_1}, \quad P_{2\text{-}2} = \log \frac{(2, 2')}{a_2},$$

$$P_{3\text{-}3} = \log \frac{(3, 3')}{a_3}, \quad P_{4\text{-}4} = \log \frac{(4, 4')}{a_4}.$$

The potential coefficients of each conductor and its image to each of the other conductors are:

$$P_{1\text{-}2} = \log \frac{(1, 2')}{(1, 2)}, \quad P_{1\text{-}3} = \log \frac{(1, 3')}{(1, 3)},$$

$$P_{1\text{-}4} = \log \frac{(1, 4')}{(1, 4)}, \quad P_{2\text{-}3} = \log \frac{(2, 3')}{(2, 3)},$$

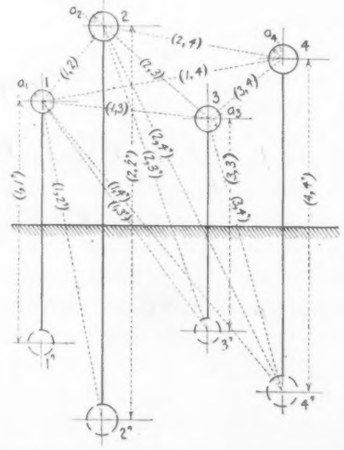


FIG. 2—POTENTIAL AND CAPACITY COEFFICIENTS DERIVED FOR FOUR PARALLEL CYLINDRICAL CONDUCTORS PARALLEL TO EARTH

$$P_{2\text{-}4} = \log \frac{(2, 4')}{(2, 4)}, \quad P_{3\text{-}4} = \log \frac{(3, 4')}{(3, 4)}.$$

A capital letter has been used for the coefficients which include the effect of both the conductor and its image in order to distinguish them from the potential coefficients used by Maxwell and others which consider the

effect of one conductor only and are usually denoted by a small letter.

Assuming that charges Q_1, Q_2, Q_3 and Q_4 are given to the respective conductors, producing potentials V_1, V_2, V_3 and V_4, the following relations exist:

$$V_1 = P_{1\cdot1}Q_1 + P_{1\cdot2}Q_2 + P_{1\cdot3}Q_3 + P_{1\cdot4}Q_4,$$
$$V_2 = P_{1\cdot2}Q_1 + P_{2\cdot2}Q_2 + P_{2\cdot3}Q_3 + P_{2\cdot4}Q_4,$$
$$V_3 = P_{1\cdot3}Q_1 + P_{2\cdot3}Q_2 + P_{3\cdot3}Q_3 + P_{3\cdot4}Q_4,$$
$$V_4 = P_{1\cdot4}Q_1 + P_{2\cdot4}Q_2 + P_{3\cdot4}Q_3 + P_{4\cdot4}Q_4.$$

If these equations are now solved for the Q's, the coefficients of the V's will be the capacity coefficients desired. This is most readily done by determinants.

Let

$$D = \begin{vmatrix} P_{1\cdot1} & P_{1\cdot2} & P_{1\cdot3} & P_{1\cdot4} \\ P_{1\cdot2} & P_{2\cdot2} & P_{2\cdot3} & P_{2\cdot4} \\ P_{1\cdot3} & P_{2\cdot3} & P_{3\cdot3} & P_{3\cdot4} \\ P_{1\cdot4} & P_{2\cdot4} & P_{3\cdot4} & P_{4\cdot4} \end{vmatrix}$$

Then

$$Q_1 = \begin{vmatrix} V_1 & P_{1\cdot2} & P_{1\cdot3} & P_{1\cdot4} \\ V_2 & P_{2\cdot2} & P_{2\cdot3} & P_{2\cdot4} \\ V_3 & P_{2\cdot3} & P_{3\cdot3} & P_{3\cdot4} \\ V_4 & P_{2\cdot4} & P_{3\cdot4} & P_{4\cdot4} \end{vmatrix} \div D$$

Expanding,

$$Q_1 = \frac{\begin{vmatrix} P_{2\cdot2} & P_{2\cdot3} & P_{2\cdot4} \\ P_{2\cdot3} & P_{3\cdot3} & P_{3\cdot4} \\ P_{2\cdot4} & P_{3\cdot4} & P_{4\cdot4} \end{vmatrix}}{D} V_1 - \frac{\begin{vmatrix} P_{1\cdot2} & P_{1\cdot3} & P_{1\cdot4} \\ P_{2\cdot3} & P_{3\cdot3} & P_{3\cdot4} \\ P_{2\cdot4} & P_{3\cdot4} & P_{4\cdot4} \end{vmatrix}}{D} V_2$$
$$+ \frac{\begin{vmatrix} P_{1\cdot2} & P_{1\cdot3} & P_{1\cdot4} \\ P_{2\cdot2} & P_{2\cdot3} & P_{2\cdot4} \\ P_{2\cdot4} & P_{3\cdot4} & P_{4\cdot4} \end{vmatrix}}{D} V_3 - \frac{\begin{vmatrix} P_{1\cdot2} & P_{1\cdot3} & P_{1\cdot4} \\ P_{2\cdot2} & P_{2\cdot3} & P_{2\cdot4} \\ P_{2\cdot3} & P_{3\cdot3} & P_{3\cdot4} \end{vmatrix}}{D} V_4$$

From this expression the capacity coefficients can be written readily as follows. When doing this it is necessary to multiply by the factor A, already mentioned to allow for the use of common logarithms and to give the result in farads per kilometer or mile. Thus:

$$C_{1\cdot1} = \frac{A}{D}\begin{vmatrix} P_{2\cdot2} & P_{2\cdot3} & P_{2\cdot4} \\ P_{2\cdot3} & P_{3\cdot3} & P_{3\cdot4} \\ P_{2\cdot4} & P_{3\cdot4} & P_{4\cdot4} \end{vmatrix}$$

$$= \frac{A}{D}\left\{\begin{array}{r} P_{2\cdot2}P_{3\cdot3}P_{4\cdot4} + 2P_{2\cdot3}P_{2\cdot4}P_{3\cdot4} - P_{2\cdot4}{}^2P_{3\cdot3} - P_{2\cdot2}P_{3\cdot4}{}^2 \\ - P_{2\cdot3}{}^2P_{4\cdot4} \end{array}\right\}$$

$$C_{1\cdot2} = -\frac{A}{D}\begin{vmatrix} P_{1\cdot2} & P_{1\cdot3} & P_{1\cdot4} \\ P_{2\cdot3} & P_{3\cdot3} & P_{3\cdot4} \\ P_{2\cdot4} & P_{3\cdot4} & P_{4\cdot4} \end{vmatrix}$$

$$= -\frac{A}{D}\left\{\begin{array}{r} P_{1\cdot2}P_{3\cdot3}P_{4\cdot4} + P_{1\cdot4}P_{2\cdot3}P_{3\cdot4} + P_{1\cdot3}P_{2\cdot4}P_{3\cdot4} \\ - P_{1\cdot4}P_{2\cdot4}P_{3\cdot3} - P_{1\cdot2}P_{3\cdot4}{}^2 - P_{1\cdot3}P_{2\cdot3}P_{4\cdot4} \end{array}\right\}$$

In a like manner:

$$C_{1\cdot3} = \frac{A}{D}\left\{\begin{array}{r} P_{1\cdot2}P_{2\cdot3}P_{4\cdot4} + P_{1\cdot4}P_{2\cdot2}P_{3\cdot4} + P_{1\cdot3}P_{2\cdot4}{}^2 \\ - P_{1\cdot4}P_{2\cdot3}P_{2\cdot4} - P_{1\cdot2}P_{2\cdot4}P_{3\cdot4} - P_{1\cdot3}P_{2\cdot2}P_{4\cdot4} \end{array}\right\}$$

$$C_{1\cdot4} = -\frac{A}{D}\left\{\begin{array}{r} P_{1\cdot2}P_{2\cdot3}P_{3\cdot4} + P_{1\cdot4}P_{2\cdot2}P_{3\cdot3} + P_{1\cdot3}P_{2\cdot3}P_{2\cdot4} \\ - P_{1\cdot4}P_{2\cdot3}{}^2 - P_{1\cdot3}P_{2\cdot4}P_{3\cdot3} - P_{1\cdot3}P_{2\cdot2}P_{3\cdot4} \end{array}\right\}$$

The expressions for Q_2, Q_3 and Q_4 give

$$C_{2\cdot2} = \frac{A}{D}\left\{\begin{array}{r} P_{1\cdot1}P_{3\cdot3}P_{4\cdot4} + 2P_{1\cdot3}P_{1\cdot4}P_{3\cdot4} - P_{1\cdot4}{}^2P_{3\cdot3} \\ - P_{1\cdot1}P_{3\cdot4}{}^2 - P_{1\cdot3}{}^2P_{4\cdot4} \end{array}\right\}$$

$$C_{2\cdot3} = -\frac{A}{D}\left\{\begin{array}{r} P_{1\cdot1}P_{2\cdot3}P_{4\cdot4} + P_{1\cdot2}P_{1\cdot4}P_{3\cdot4} + P_{1\cdot3}P_{1\cdot4}P_{2\cdot4} \\ - P_{1\cdot4}{}^2P_{2\cdot3} - P_{1\cdot1}P_{2\cdot4}P_{3\cdot4} - P_{1\cdot2}P_{1\cdot3}P_{4\cdot4} \end{array}\right\}$$

$$C_{2\cdot4} = \frac{A}{D}\left\{\begin{array}{r} P_{1\cdot1}P_{2\cdot3}P_{3\cdot4} + P_{1\cdot2}P_{1\cdot4}P_{3\cdot2} + P_{1\cdot3}{}^2P_{2\cdot4} \\ - P_{1\cdot3}P_{1\cdot4}P_{2\cdot3} - P_{1\cdot1}P_{2\cdot4}P_{3\cdot3} - P_{1\cdot2}P_{1\cdot3}P_{3\cdot4} \end{array}\right\}$$

$$C_{3\cdot3} = \frac{A}{D}\left\{\begin{array}{r} P_{1\cdot1}P_{2\cdot2}P_{4\cdot4} + 2P_{1\cdot2}P_{1\cdot4}P_{2\cdot4} \\ - P_{1\cdot4}{}^2P_{2\cdot2} - P_{1\cdot1}P_{2\cdot4}{}^2 - P_{1\cdot2}{}^2P_{4\cdot4} \end{array}\right\}$$

$$C_{3\cdot4} = -\frac{A}{D}\left\{\begin{array}{r} P_{1\cdot1}P_{2\cdot2}P_{3\cdot4} + P_{1\cdot2}P_{1\cdot4}P_{2\cdot3} + P_{1\cdot2}P_{1\cdot3}P_{2\cdot4} \\ - P_{1\cdot3}P_{1\cdot4}P_{2\cdot2} - P_{1\cdot1}P_{2\cdot3}P_{2\cdot4} - P_{1\cdot2}{}^2P_{3\cdot4} \end{array}\right\}$$

$$C_{4\cdot4} = -\frac{A}{D}\left\{\begin{array}{r} P_{1\cdot1}P_{2\cdot2}P_{3\cdot3} + 2P_{1\cdot2}P_{1\cdot3}P_{2\cdot3} - P_{1\cdot3}{}^2P_{2\cdot2} \\ - P_{1\cdot1}P_{2\cdot3}{}^2 - P_{1\cdot2}{}^2P_{3\cdot3} \end{array}\right\}$$

$$D = P_{1\cdot1}\left\{\begin{array}{r} P_{2\cdot2}P_{3\cdot3}P_{4\cdot4} + 2P_{2\cdot3}P_{2\cdot4}P_{3\cdot4} - P_{2\cdot4}{}^2P_{3\cdot3} \\ - P_{2\cdot2}P_{3\cdot4}{}^2 - P_{2\cdot3}{}^2P_{4\cdot4} \end{array}\right\}$$
$$- P_{1\cdot2}\left\{\begin{array}{r} P_{1\cdot2}P_{3\cdot3}P_{4\cdot4} + P_{1\cdot4}P_{2\cdot3}P_{3\cdot4} + P_{1\cdot3}P_{2\cdot4}P_{3\cdot4} \\ - P_{1\cdot4}P_{2\cdot4}P_{3\cdot3} - P_{1\cdot3}P_{3\cdot4}{}^2 - P_{1\cdot2}P_{2\cdot3}P_{4\cdot4} \end{array}\right\}$$
$$+ P_{1\cdot3}\left\{\begin{array}{r} P_{1\cdot2}P_{2\cdot3}P_{4\cdot4} + P_{1\cdot4}P_{2\cdot3}P_{3\cdot4} + P_{1\cdot3}P_{2\cdot4}{}^2 \\ - P_{1\cdot4}P_{2\cdot3}P_{3\cdot4} - P_{1\cdot2}P_{3\cdot4}P_{3\cdot4} - P_{1\cdot2}P_{2\cdot3}P_{4\cdot4} \end{array}\right\}$$
$$- P_{1\cdot4}\left\{\begin{array}{r} P_{1\cdot2}P_{2\cdot3}P_{3\cdot4} + P_{1\cdot4}P_{2\cdot2}P_{3\cdot3} + P_{1\cdot3}P_{2\cdot3}P_{2\cdot4} \\ - P_{1\cdot4}P_{2\cdot3}{}^2 - P_{1\cdot2}P_{2\cdot4}P_{3\cdot3} - P_{1\cdot3}P_{2\cdot2}P_{3\cdot4} \end{array}\right\}$$

For three conductors the capacity coefficients are obtained by omitting from the determinants the coefficients of the fourth conductor. Thus:

$$C_{1\cdot1} = \frac{A}{D}\left\{P_{2\cdot2}P_{3\cdot3} - P_{2\cdot3}{}^2\right\}$$

$$C_{1\cdot2} = -\frac{A}{D}\left\{P_{1\cdot2}P_{3\cdot3} - P_{1\cdot3}P_{2\cdot3}\right\}$$

$$C_{1\cdot3} = \frac{A}{D}\left\{P_{1\cdot2}P_{2\cdot3} - P_{1\cdot3}P_{2\cdot2}\right\}$$

$$C_{2\cdot2} = \frac{A}{D}\left\{P_{1\cdot1}P_{3\cdot3} - P_{1\cdot3}{}^2\right\}$$

$$C_{2\cdot3} = -\frac{A}{D}\left\{P_{1\cdot1}P_{2\cdot3} - P_{1\cdot2}P_{1\cdot3}\right\}$$

$$C_{3\cdot3} = \frac{A}{D}\left\{P_{1\cdot1}P_{2\cdot2} - P_{1\cdot2}{}^2\right\}$$

$$D = P_{1\cdot1}\left\{P_{2\cdot2}P_{3\cdot3} - P_{2\cdot3}{}^2\right\} - P_{1\cdot2}\left\{P_{1\cdot2}P_{3\cdot3} - P_{1\cdot3}P_{2\cdot3}\right\}$$
$$+ P_{1\cdot3}\left\{P_{1\cdot2}P_{2\cdot3} - P_{1\cdot3}P_{2\cdot2}\right\}$$

In the expansion of D the quantity in the first parenthesis will be the same as that obtained in the parenthesis when expanding $C_{1\cdot1}$; the second parenthesis will be the same as for $C_{1\cdot2}$; the third as in $C_{1\cdot3}$, and the fourth as in $C_{1\cdot4}$. This simplifies the calculation considerably.

Only the capacity coefficients between the conductors and the ground remain to be found. They are readily obtained on the basis that the sum of all the capacity coefficients is zero. Denoting these values by $C_{1\cdot g}$, $C_{2\cdot g}$, $C_{3\cdot g}$, $C_{4\cdot g}$,

$$C_{1\cdot1} + C_{1\cdot2} + C_{1\cdot3} + C_{1\cdot4} + C_{1\cdot g} = 0$$

Hence:

$$C_{1\cdot g} = -(C_{1\cdot1} + C_{1\cdot2} + C_{1\cdot3} + C_{1\cdot4})$$

In a like manner:

$$C_{2\cdot g} = -(C_{1\cdot2} + C_{2\cdot2} + C_{2\cdot3} + C_{2\cdot4})$$
$$C_{3\cdot g} = -(C_{1\cdot3} + C_{2\cdot3} + C_{3\cdot3} + C_{3\cdot4})$$
$$C_{4\cdot g} = -(C_{1\cdot4} + C_{2\cdot4} + C_{3\cdot4} + C_{4\cdot4})$$

The value of the factor A to give the capacity coefficients in any desired unit for any unit of length may be readily derived. The most useful values are given in the following table:

To Reduce to	A	Log A
Farads per kilometer	$2.4127 \cdot 10^{-8}$	$2.38251 - 10$
Farads per mile	$3.8830 \cdot 10^{-8}$	$2.58916 - 10$

The remainder of this article, which will be published in a subsequent issue of the ELECTRICAL WORLD, indicates the method of computing the charging currents of a three-phase circuit when one phase is grounded. Two cases are considered, one when the conductors are not transposed and the other when the conductors are transposed a complete number of turns. Several typical examples are worked out, and the results obtained by calculation are compared with test data.

SPECIAL TESTING APPARATUS OF BOSTON EDISON COMPANY

Description of Condenser, Rheostats and Resistance Units Used in the Standardizing and Testing Department

BY C. L. KASSON

Several special pieces of testing apparatus have been constructed during the past year in the standardizing and testing department of the Edison Electric Illuminating Company of Boston. Among these are a 30-microfarad condenser, a series and a multiple carbon rheostat, a 15-amp. test load, a 60-amp. test load and a 20-amp. testing rheostat. The condenser is shown as

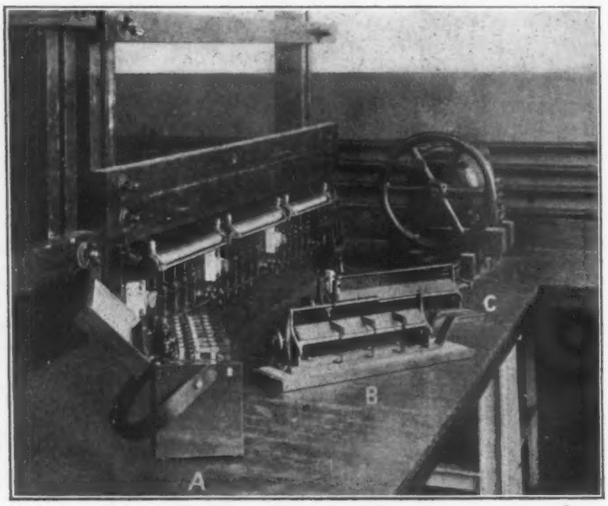


FIG. 1—SPECIAL CONDENSER (A); MULTIPLE CARBON RHEOSTAT (B), AND SERIES CARBON RHEOSTAT (C), USED IN TESTING LABORATORY OF BOSTON COMPANY

A in Fig. 1. This consists of thirty 1-microfarad, 300-volt paper condenser units assembled in a mahogany box, provided with nine single-pole, double-throw switches in the top under the cover. These condensers are divided into three groups of 10 microfarads each. Each group has three switches, so wired that they control 1, 3 and 6 microfarads respectively. When the switch is thrown one way the condenser is charged, and when it is thrown the other way the condenser is discharged. With this grouping it is possible to use the condenser for experimental work on single or three-phase circuits, and in series or multiple on single-phase circuits. The box is provided with removable cover, which protects the switches and terminals, and with a strong carrying strap. The outside dimensions are: length, 12.5 in. (31.75 cm.); width, 6 in. (15.24 cm.); height, 7 in. (17.78 cm.), and its weight is 20 lb. (9 kg.).

A multiple carbon rheostat *B* and a series design *C* are also shown in Fig. 1. Both of these rheostats are made of about 115 carbon blocks 1.5 in. (3.81 cm.) square and 0.25 in. (0.64 cm.) thick, carried in a small angle-iron frame insulated with asbestos and supported at the ends with suitable brass castings. These castings rest on a wooden base covered with asbestos and are tied across the top by a rod. The blocks are squeezed together by a screw and small hand-wheel in one of the end castings. The series rheostat has one insulated copper contact sliding on the tie rod, which can be inserted anywhere in the carbon pack. The multiple rheostat has several semi-fixed copper contacts in the carbon pack connected in multiple to heavy copper lead strips on the base. The series rheostat will handle currents up to about 100 amp. and the multiple one up to 400 amp., when the total watts do not exceed approximately 800 and the time of operation is not too long. For long-time work the wattage should not exceed about 400 unless the rheostat is cooled by a blast of air from a fan. These rheostats weigh about 15 lb. (6.75 kg.).

In Fig. 2 at *A* and *B* are shown a 15-amp. and a 60-amp. testing load. The former consists of three fabric resistance units rated at 5 amp. each at 110 volts, mounted in light tubular frames hinged together. The resistance units are insulated from the frame and terminals are brought out at the top. The three frames are hinged so that when open the rheostat stands with the resistance units vertical and when folded flat it packs into a light, thin metal carrying case. The three resistance units can be used individually or in multiple.

The design marked *B* of Fig. 2 consists of six 10-amp. fabric-resistance units mounted in three frames, as described before. These units can be used individually or in series, series-multiple or multiple. The carrying case of the 15-amp. rheostat measures 9.5 in. (24.13 cm.) long, 2.5 in. (6.35 cm.) wide, 9.5 in. (24.13 cm.) high, and that of the 60-amp. 12.5 in. (31.75 cm.) long, 3.5 in. (8.89 cm.) wide, 9.5 in. (24.13 cm.) high. The weight of the former rheostat, including case, is 4 lb. (1.8 kg.) and of the latter is 8 lb. (3.6 kg.).

The unit marked *C* in Fig. 2 is a 20-amp. meter-testing rheostat for testing station ammeters, indicating wattmeters, watt-hour meters, relays, etc. This is composed of eight fabric-resistance units ranging from 5 amp. capacity to 0.5 amp. at 110 volts, all mounted in a steel and brass frame with an asbestos board front. This front carries switches and terminals for the wires from the source of power, current and potential wires to the meter under test, and wires to a small slide-wire, fine-adjustment rheostat. The switches include one

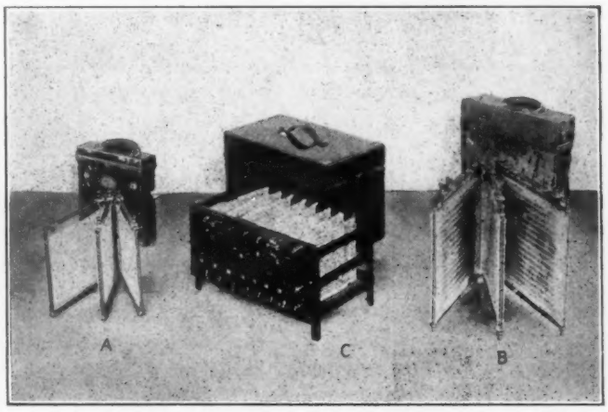


FIG. 2—A 15-AMP. AND A 60-AMP. TESTING LOAD (A AND B) AND 20-AMP. METER-TESTING RHEOSTAT (C) USED BY BOSTON COMPANY

double-pole, double-throw, power-reversing switch, a short-circuiting one for the current terminals, a double-pole, single-throw switch for the potential circuit, and a single-pole, single-throw switch for each of the eight resistance units. This rheostat is light, non-inflammable and compact. It is provided with a metal carrying case, whose dimensions are: length, 16 in. (40.64 cm.); width, 9.5 in. (24.13 cm.); height, 10.25 in. (31.8 cm.). The weight of rheostat and case is 15 lb. (6.75 kg.).

Coal Rates and New-Business Policy

Reports from Central Western Cities Show a Wide Diversity in Effect of War-Time Conditions Upon Present Plans and Arrangements for the Future—Situation in Michigan, Cleveland and Columbus

COAL conditions, the great demand for energy from power consumers already on the lines, the drift of discouraged isolated-plant owners to central station service and the varying effect of war in different communities have combined to affect the attitude of companies in Central Western cities on the subject of new business. The heavy loads upon generating apparatus and the impossibility of getting new equipment promptly are factors which many companies have had to take into definite account in framing their new-business policy for 1917 and the ensuing year.

Investigation of conditions in Central Western cities by the ELECTRICAL WORLD shows that these factors, affecting companies differently according to the effect in their individual communities, make it possible to classify the central stations roughly in four distinct groups. The factors are somewhat intermingled as to the relative degree of influence on company policy, but they give approximately these classes:

CLASSIFYING THE PROPERTIES

First, properties which have been forced by heavy demands from power users virtually to decline new business of any material amount. This is because of unparalleled magnitude of growth in the last three years; it represents in some cases the absorption of new generating capacity ordered in anticipation of future development which was not realized in 1914. Surplus equipment has been fully absorbed, and the overloaded condition of plants is accelerating the process of physical depreciation, while it is feared that rates have not been advanced sufficiently to overcome abnormally rapid deterioration.

Second, properties which are taking the new business that is offered without solicitation, but are not developing new-business connections or prospects with so much energy as heretofore; in short, are taking what comes easily but are not going far, if any distance, from existing lines. Even such business as is taken under these circumstances is not always welcomed by the operating department, which rather discourages additions to existing loads.

Third are the central stations in districts whose industries and financial welfare are affected adversely by war. Such properties have in the population which they serve not only a lack of special industrial stimulus and profit due to war; they have also the increased cost of living which is an inevitable result of war and touches every home. In communities of this character the war restricts luxury buying, it means economy in expenditure, but it makes the necessity of new-business solicitation urgent for the future if not for the present. In other words, normal rate of growth is maintained less easily and, looking to the future, the business of the type which requires solicitation over a long period is still open to argument.

Fourth is the class of plants in communities which have abounded with war prosperity and sense no decline in activity because this country has entered the conflict, but expect rather a continued speeding up of every industry. These properties faced such enormous demands for power early in the European war development that they planned for additional capacity on a large scale and have found their expansion plans more than justified. In these communities there is no sign of curtailment in demand.

UNDERLYING QUESTIONS

In all of the characteristic properties outlined in the foregoing there is an element of misgiving because of coal conditions; of uncertainty because of the unknown status which the labor problem will hold; of doubt as to what level costs will reach; of still unsatisfied questions about rates, and of inclination to reach farther and farther ahead in planning to shape the generating and distribution systems for the future.

Specific reports given to the ELECTRICAL WORLD in some of the cities visited on a recent trip of investigation follow:

RUSHING ADDITIONAL CONSTRUCTION, SAYS MR. TIPPY

C. W. Tippy, general manager Consumers' Power Company, Jackson, Mich., made the following statement to the ELECTRICAL WORLD:

The Consumers' Power Company serves about seventy-five cities and towns interconnected by transmission lines and scattered over the greater part of Michigan. The energy is generated by hydroelectric stations on the more important rivers, backed up by steam plants in the various cities.

The amount of coal we use will depend, of course, in a great measure on the character of the season and the amount of energy which can be generated in the hydroelectric plants. We regard the coal situation as very serious and hope to come into the winter with a liberal supply of coal in stock. We were greatly hindered last year in securing our coal supply by the embargoes placed at the different points. We were able to overcome this for a time by buying coal in different sections of the country until embargoes were placed in these districts.

If the railroads can provide locomotives to handle cars, it will do much to relieve the situation. It looks as if the policy of holding down the earnings of the railroads is, in a great measure, to blame for this congestion, as it has kept the roads from growing with the demands of the country. There appears to be much unnecessary travel which might be eliminated and thus release locomotives and track capacity to expedite the movement of freight.

Coal production appears to be the greatest in our history, but the requirements of industry and the individual consumers have outstripped production. A generation ago the average family was satisfied to have one or two rooms heated, but now the average family is not satisfied unless the whole house is heated by a furnace. This greatly increases the use of coal for domestic consumption and enters largely into the problems of transportation during the winter months.

It is not to be doubted that railroad conditions are much better now than they have been for some time so far as coal movement is concerned. At the same time, it should be remembered that this is the easy period of the year for handling freight. When the extreme cold of winter hits us, it greatly reduces pulling capacity of the locomotives, and

thus greatly increases the problems of the railroads in handling freight.

Our business continues to grow. We are taking on all new business that is offered when it is along our existing lines. The increase in June over last year shows about the same growth as in the earlier months. Merchandising business is excellent and we are making a very satisfactory showing in the sale of sweepers, washing machines, fans and irons. Our plants are virtually loaded to capacity and we are rushing construction on three additional hydroelectric stations and also installing two 10,000-kw. units in steam in order to take care of the demand. We do not see any indication of letting up in business activities.

We have had to increase our optional and power rates on account of the higher operating costs due to coal, labor and materials. This increase has been held entirely to optional rates, not disturbing franchise rates. The increase in primary power rates is larger in percentage than the optional commercial lighting rates, or secondary power, where the average rate earned was higher. The advance ranges from 10 per cent to 30 per cent, averaging perhaps 20 per cent on all classes of business affected.

In increasing our rates we have gone directly to the consumers with a complete explanation as to the necessity of the increase, explaining that we are giving them the benefit of our hydroelectric generation and not asking the amount which would be necessary if we generated entirely by steam. In most cases our customers have accepted the increase, fully realizing the conditions confronting us.

The obligation of furnishing service rests upon central stations, and it is possible that it may be necessary for them to cut off certain classes of business, such as signs and display lighting, in order to save fuel.

Conditions in Columbus

The Columbus (Ohio) Railway, Power & Light Company states that the higher coal cost was felt by the company in August, 1916, and it was some months afterward before it was decided to increase power and light rates so as to meet the higher operating expenses. At the beginning it was supposed that conditions were temporary; it was not believed that they would last or become so much more serious.

W. A. Wolls, manager of the new-business department, states:

A new increased schedule of rates was sent to the patrons of the company affected on May 28, and the schedule became effective on June 21. Our letter accompanying a copy of the schedule to our patrons showed that the company consumed annually over 110,000 tons of coal. It showed that in the nine months just preceding the company had borne silently the burden of steadily increasing coal cost, which in that period amounted to over 100 per cent. In the last three months of this period the increase was 140 per cent.

It had been our hope, the letter to patrons stated, that the abnormal coal cost might be only temporary and that the price would have receded before that date. We stated that we would be very glad upon request to furnish figures applying the new rates to the amount of energy furnished in any past month, to serve as an example for estimating future business. To this letter we received some replies but not many.

Although Columbus has not been stimulated by war industries, the people accept the fact of increased coal cost. The higher rates are not applied to residence or charitable institution consumers, but reach generally the power and commercial lighting classes.

In our new schedule we did not introduce coal clauses, as the public utility law evidently requires specific rates, and coal clauses make the rate indefinite and depend upon a coal cost which could not be determined in advance.

Because of the local condition that the industries of Columbus are not those of war, we abandoned an elaborate house-wiring campaign when this country became involved in a state of war. We are accepting business which comes and are continuing to solicit power business of the class which will not require serving until some future date near the end of the present year. Although our power plants are being operated virtually at capacity, our new generating station is scheduled to be completed in the fall and will give us a new margin of energy to sell.

Looking Ahead in Cleveland

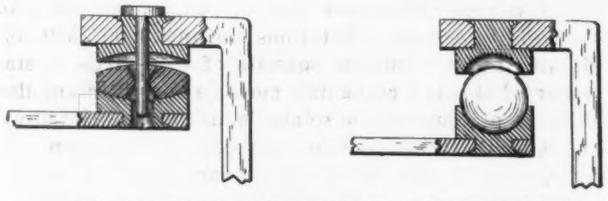
In preparing for the coming winter the Cleveland Electric Illuminating Company has bought a tract of land adjoining the location of its Seventieth Street generating station and is clearing it for use as an addition to the coal-storage yard. This will about double the coal-storage capacity of the company. Arrangements have already been completed for laying tracks to the new land and the material is on hand. Ordinarily the company plans to hold one month's supply in reserve, but an effort will be made during the next fall and winter to maintain the supply at two months' requirements.

So great has been the demand for energy for industrial purposes that the present generating capacity is virtually sold. Several months ago the company dismissed a number of employees in the new-business department, and it has not announced a time when solicitation for contracts will be resumed. No public announcement has been made by the company that new contracts cannot be taken, as in the case of the municipal plant in Cleveland, but that is understood to be the present situation.

Additional generating apparatus has been ordered for delivery up to and including 1919 to cover the estimated larger requirements of this period. It is felt that no decrease in the demand for energy is to be expected during the present calendar year at any rate and that any let-up in consmption by one group of customers will be offset by increased requirements from others.

Vibrator Contacts for Tirrill Regulator

A loose contact member to avoid pitting due to arcing is provided for the make-and-break circuit of Tirrill regulators in patent No. 1,223,143, issued to Stephen F. Briggs of Milwaukee, Wis. This contact member is free to turn by the action of the contact points thereon



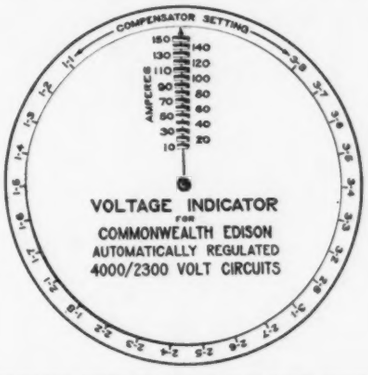
LOOSE CONTACT MEMBER USED TO AVOID PITTING

to change the point of arcing and distribute it over a broad surface during a succession of operations. Preferably the lower contact point has its upper surface concave instead of convex, and the intermediate contact member has a convex upper and lower surface. The opening thus formed is of an hourglass shape to permit a slight rocking of the intermediate contact member in its concave seat and also to permit it to turn. A further modification of this is where the intermediate contact member is in the form of a ball or sphere confined between the spherically convex surfaces of the contact points. With this construction there is no necessity for the use of an insulating pin as the space between the contact points is insufficient to permit the spherical contact member to pass through.

HAND CONTROL OF VOLTAGE

Calculator Devised for Determining Amount of Line-Drop Compensation Necessary

In plants where the automatic control of voltage is employed the most common causes of poor regulation are burning of regulator contacts, dirt between contacts, excessive friction of moving parts, strained and broken contractor springs, broken wires, and an accidental change of compensation at the time of cleaning contact makers. Whenever one of these troubles arises or the regulator control has to be taken out of service for any reason, it is necessary to control the voltage by hand. To do this properly an operator must know how much to allow for line drop. Even if the constants of each circuit were known, not enough time is afforded in emergencies to calculate drop. While some companies furnish their operators with charts which give this information directly, it is usually inconvenient to use them, since a chart is required for each circuit,



CELLULOID DEVICE FOR INDICATING VOLTAGE

and they are, besides, easily damaged by handling and must be changed whenever the length or characteristics of the corresponding circuit are altered.

To avoid these shortcomings and difficulties the Commonwealth Edison Company of Chicago, which has the largest number of circuits in the world, is using celluloid voltage calculators like the one shown here in each of its sixteen substations serving 4000/2300-volt circuits. The calculator consists of two parts—a stationary disk and a concentric movable one. Rectangular slots are provided in the rotatable disk along one radius, and opposite these are values indicating loads from zero to full load. Around the stationary disks, to correspond to the outer slot in the movable disk, are values indicating settings commonly employed with voltage-regulator contact makers. Below these values, along radial lines, and arranged in such a way as to correspond to the remaining slots on the movable disk, are values indicating the corresponding voltages which must be maintained at the station end of circuits with different loads to secure constant voltage at the delivery ends. With this calculator an operator does not have to know the length or characteristics of various circuits. All the information needed is the contact-maker setting and the percentage of full-load current flowing in the line. Then the upper dial is turned until the contact-maker setting appears in the upper slot. Below, opposite the percentage of full-load current, appears the voltage which must be maintained at the station end of the line.

Strictly speaking, this calculator is not correct for circuits having high reactance and changing power factor, since it was designed to do what the compensated type of contact maker does, and no more. Where a calculator is required to determine the voltages which would be maintained at the station end of a line by a line-drop compensator under different loads it should be a simple matter to modify the scheme just described. It may be pointed out in this connection that the additional cost and complication of line-drop compensators was not warranted on the Chicago network because of the way in which the relatively large amount of underground cable with its small interaxial spacing of conductors affects the relation of the reactance to the resistance of the circuits. With the existing characteristics of the circuits and the loads it has been found that if the voltage regulation is maintained within sufficiently close limits for the lighting or high-power-factor load it will be within the limits required by the public utilities commission for the power load. Consequently the contact maker is set to correspond to the average power factor or actual power factor of the lighting load, the power-current regulation being allowed to be what it will.

Extensive tests made on different circuits under different loads proved that the possible error of the calculator is not more than the possible error of station-indicating voltmeters and ammeters, the error due to operators reading them, and the error in the increment of change in the compensating taps of the compensating coils of the contact makers. During the two years that the calculators have been in use they have given very satisfactory service. They have relieved the operators of the need to use less convenient methods of controlling regulators by hand, have made it possible to detect abnormalities of operation, and have permitted the operators to check the operation of the automatic regulator control. As a result, the uniformity of service has been improved. The calculators used in Chicago measured 4¼ in. (10.9 cm.) by 6 in. (15.2 cm.). While they are made of celluloid, it would be less expensive and more desirable, where only a few calculators are to be made, to employ millboard instead of celluloid, and make them a little larger.

Method for Welding Thin and Scaly Metals

The invention of Carl B. Auer of Wilkinsburg, Pa., patent No. 1,229,700, is directed in particular to the welding together of the sheets and ribbons of metal which quickly tarnish in the air and which therefore become covered with a film or scale that seriously interferes with ordinary welding methods. Thin metal sheets and ribbons may be easily welded together by ordinary processes of incandescent electric welding if their surfaces are clean. However, great difficulty is found in cleansing ribbons of nickel-chromium alloys which are now extensively used in making electric resistance elements, for the reason that the oxide scale on these alloys frequently cannot be removed by ordinary rubbing with emery paper. By the simple expedient of embossing the thin strips by means of a pair of pliers furnished with closely studded small projections it is found that the surfaces can be readily welded together.

STATION AND OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

COSTS OF MATERIALS PRINTED IN ORDER TO INSPIRE ECONOMY

Eastern Company Compares Present Costs with Last Year's Prices—How the Value of the Dollar Has Shrunk

In the June issue of *Service*, a publication of the Public Service Company of New Jersey, there appeared the accompanying partial list of items used by many departments of the company. The prices marked represent the present cost of what $1 worth of these items cost about one year ago. These prices were printed to impress upon the minds of the employees the economical use that must be made of these materials. In the article several suggestions were also made. It was pointed out that all odds and ends must be gathered up instead of leaving them behind on the job. Small hardware should be handled carefully. More material should not be requisitioned than is actually needed. Wire should be measured carefully, so that as little as possible is cut to scrap.

One dollar's worth of:	Now Costs	One dollar's worth of:	Now Costs
Fuse plugs	$1.75	Asbestos listing, 3-in	$4.10
Brackets, galvanized	1.74	Boiler tubes	2.71
Cheese cloth	1.68	Lag screws	2.68
Iron castings, shakers	1.67	Cable	2.55
Varnished insulating cloth	1.65	Carriage bolts	2.50
Engine oil	1.64	Wire W. P. T. B.	2.47
No. 1075 insulators	1.63	Braces (cross-arm)	2.45
Shovels	1.61	Condenser tubes	2.25
Cotton waste	1.60	Rope, manila	2.23
Solder	1.57	Bolts, galvanized machine	2.21
Iron pipe, black	1.54	Shellac	2.20
Iron pipe, galvanized	1.46	Lead sleeving	2.19
Fuses	1.43	Pole steps	2.06
Pike poles	1.33	Conduit, galvanized	2.06
Varnished tape	1.33	Guy clamps	1.95
Cant hooks	1.25	Round washers	1.88
Fire extinguishers, Pyrene	1.14	Square washers	1.85
Pins, locust	1.10	Raw linseed oil	1.80

ASCERTAINING CAUSE OF BAD VOLTAGE REGULATION

Regulator in a Large Manufacturing Plant Was Found to Be Placed in Wrong Section of System—Remedy Easily Applied

BY A. C. HEWITT

Bad voltage regulation was experienced for several years by a large manufacturing plant which had a connected load of about 1400 hp. in motors, and which is at the end of a 22-mile (35.4-km.) transmission line. This line consisted of three No. 2 copper wires carrying current at 22,000 volts, feeding several factories along the line. The plant in question demanded an average of 300 kw. Installed there were two hoist motors that operated intermittently with a maximum instantaneous load on each of about 100 kw. The momentary voltage fluctuations due to the hoists were not so serious in themselves as was the prolonged drop from 7.30 a. m. to noon and from 1 p. m. to 4.30 p. m., as is shown in chart No. 1. From this chart it can also be seen that the voltage ran very high during the night.

The power plant furnishing energy to this line consisted of five 500-kva. water turbines in one building, with a 1500-kva. steam turbine plant as an auxiliary located about 1000 ft. from the water-power plant. The transformers, switchboard and voltage regulator are located in the water-power plant, as this plant was the first one constructed by the power company. After the steam plant was built, a substation containing arresters and transformers was built to handle all the outgoing

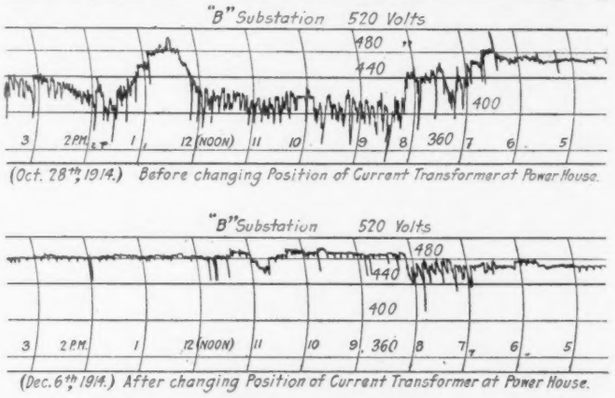


FIG. 1—VOLTAGE AT END OF TRANSMISSION LINE BEFORE AND AFTER CHANGING POSITION OF CURRENT TRANSFORMER

power from both plants. The voltage regulator was a standard Tirrill regulator suitable for handling several generators operating with two exciters. The regulator had a compensating device which would boost the voltage when the load increased. The compensator was set so as to maintain steady voltage at the center of the distribution system. When the steam plant was added,

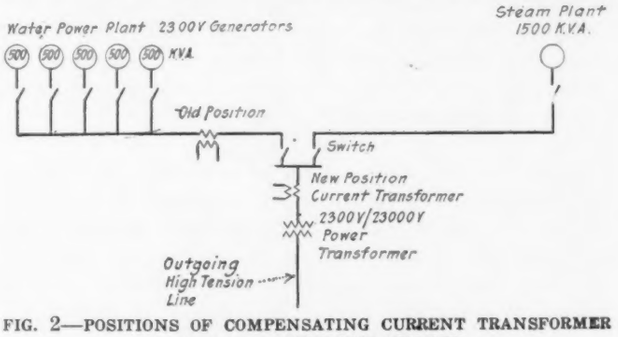


FIG. 2—POSITIONS OF COMPENSATING CURRENT TRANSFORMER BEFORE AND AFTER THE CHANGE

the steam turbine got its excitation from the exciters in the water plant and was therefore supposed to be controlled by the voltage regulator in this plant.

After a careful investigation of the conditions it was found that the regulator was placed in the wrong section of the system, as shown in Fig. 2. Apparently, during reconstruction, the engineers ignored the voltage regulator when the steam plant and substation were constructed, thinking that because the regulator con-

trolled the exciter voltage it therefore controlled the voltage of the main generators. However, the water turbines were operated with locked gates and the governor allowed to take care of all variations in the load carried. Since a current transformer controlled the voltage regulator so that the voltage would rise as the load increased, and vice versa, thereby automatically compensating for variations in transmission losses, and since this current transformer was placed on the outgoing line from the water plant instead of the outgoing lines from the substation, the regulator simply maintained a steady voltage at the power plant instead of at the center of the distribution system. As the center of distribution was 10 miles (16 km.) from the power house, the result was a very irregular voltage at the extreme end of the transmission line. The condition was soon remedied and the result was much better voltage regulation, as shown in the chart taken after the change.

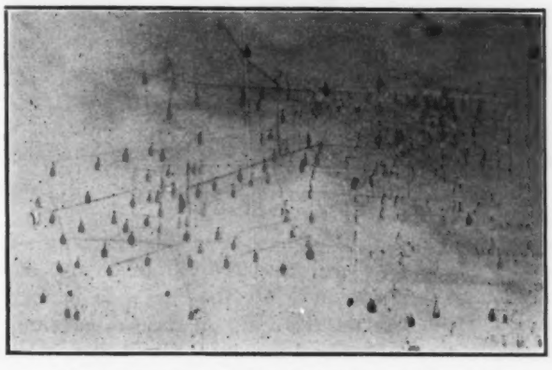
MAP USED FOR KEEPING "TAB" ON TRANSFORMERS

Routes of Circuits Indicated Thereon—Tag Attached at Each Transformer Position to Give Information Regarding Rating, Etc.

BY N. NESBITT TEAGUE

Augusta-Aiken Railway & Electric Corporation, Augusta, Ga.

The Augusta-Aiken Railway & Electric Corporation has mounted a map of its system on a strip of beaver board and indicated the position of each transformer thereon with tacks to which tags are attached. Each tag contains information as to size, kva., company number, etc., affording ready information for transformers that are to be replaced for burn-outs or to be regrouped without referring to the history cards. Differently colored tags are used, green representing underground



TAGS REPRESENT TRANSFORMERS ON THIS MAP

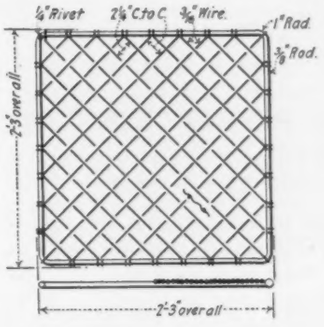
transformers, white indicating the 2300-volt overhead type, yellow the 13,200-volt type, and red the 44,000-volt transformers. If more information is desired, reference is made to the history cards, which are kept up to date. When setting or removing any transformer the line department turns in a special card giving information on the changes made. Apparatus that is in stock or in the repair shop is indicated in the lower right-hand corner of the map. The method of indicating transmission and distribution details was developed under the supervision of J. J. Borger, general superintendent of the electrical department.

INNER COVER USED FOR RECTANGULAR MANHOLES

Made of Interlaced Wire Stretched Over a Frame, It Is Designed to Prevent the Manhole Cover from Falling Into the Hole

BY R. A. PAINE, JR.

The Edison Electric Illuminating Company of Brooklyn, N. Y., has recently designed and placed on its system an improved form of inner cover for square and oblong manhole castings. This is used in order to prevent the cover from dropping into the manhole. The cover consists of a rim of ⅜-in. (9.5-mm.) galvanized-steel rod across which 3/16-in. (4.8-mm.) galvanized-steel wire is stretched diagonally at 2-in. (5.1-cm.) intervals in both directions and interlaced. The wire is turned over the rim before galvanizing.



WIRE-MESH FRAME FOR MANHOLE OPENING

The screen has several advantages over the old inner cover. The old inner cover was made of cast iron with several small holes to allow for ventilation. These holes quickly became stopped up, and often the entire space between the inner and outer covers became filled with dirt and trash which prohibited ventilation. This was particularly objectionable in the winter, when the dirt would be frozen, making it very difficult to open the manhole. The new screen allows any dirt, etc., which may come through the holes in the outer cover to go through it to the bottom of the manhole. When men are working in a manhole and it is not necessary to be constantly passing material in and out the screen is placed in position as a protection to the workmen. The screen will withstand a load of 400 lb. (181.4) kg. placed at its center, without dangerous deflection.

QUICK WORK MOVING TRANSFORMER STATION

300-Kva. Outdoor Substation Disassembled, Removed to New Location and Installed in Remarkably Short Time

BY E. B. HOOK, JR.

Superintendent of Construction Georgia Railway & Power Company

The Georgia Railway & Power Company recently had occasion to install a 300-kva. outdoor transformer station in extraordinarily quick time. A large government institution in Atlanta desired to discontinue its steam-driven electrical plant and use central station service. The construction department was ordered to build a transmission line and erect the desired substation within the week. This work usually requires from two to three weeks under most favorable conditions, and, as usual on rush jobs, it was found impossible to secure delivery of transformers or the fabricated steel angle iron to support the buses.

Another customer in the vicinity of Atlanta had recently failed in business and closed down its plant. The

transformers at this plant were just of the rating desired, so it was decided to move the entire station over to the new customer, a distance of some 7 or 8 miles (11.3 km. or 12.9 km.). Accordingly, two picked crews were mobilized and sent out to disassemble and move the station. A specially built, underslung steel wagon of 12-ton (10.8-t.) capacity was used with four mules for hauling the three 100-kva. transformers at one load. The steel work of the station and the buses, insulators, lightning arresters and switches were loaded into two large trucks. In this manner the complete substation was disassembled, loaded and moved away in less than half a day and completely installed at the new location two days later.

SALVAGING PIPE FITTINGS

Muriatic-Acid Bath in Combination with a Steam Coil Removes Thick Coat of Scale

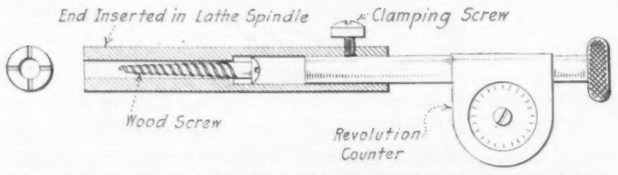
Old pipe fittings removed in rearranging the piping layout at the Galesburg (Ill.) central station were on their way to the junkman when it was decided to clean them and save them for future use if possible. They had all seen years of service and were heavily coated with scale, which forms readily at Galesburg, owing to undesirable water conditions. To remove this an apparatus consisting of a steel oil barrel with the head cut out and a steam coil laid inside it was rigged. Above the barrel was placed a chain hoist. The pipe fittings were placed one by one in this barrel, which was filled with a twenty-to-one solution of muriatic acid, and steam was admitted to the coil. This acid cooking process softened the scale so that it could be easily removed. After the bath and the cleaning process the fittings were painted and were again ready for service. With prices of iron at the present level the saving thus effected amounted to a very comfortable sum.

COUNTING THE TURNS

Method of Attaching Revolution Counter to Head of Lathe Used in Winding Coils

BY R. L. HERVEY

Since it is usually difficult to keep count of the number of turns of wire applied to large coils, such as are used for motor fields or induction coils, a method is suggested herewith which makes use of a simple me-



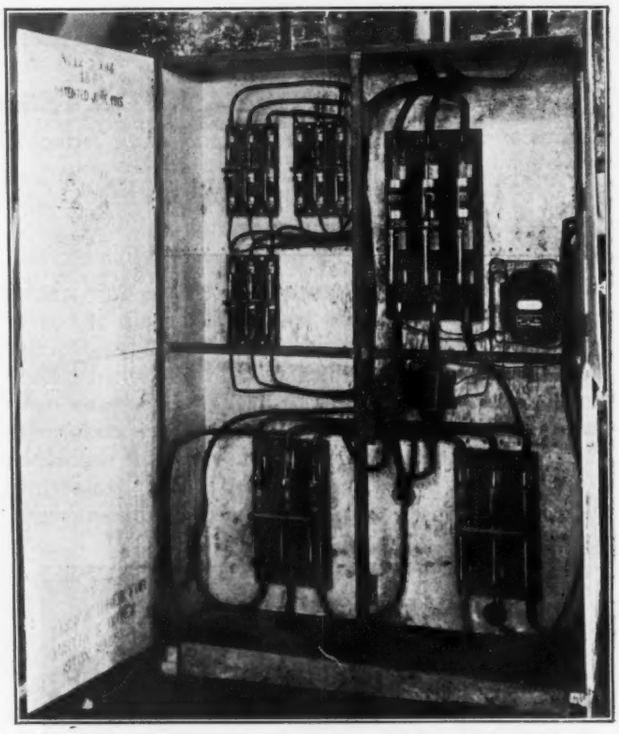
PLUG FOR ADAPTING REVOLUTION COUNTER TO LATHE SPINDLE

chanical counter. An ordinary revolution counter can be employed. To attach it to the lathe spindle use can be made of a round-fiber or hard-wood plug which will just fit into the outside end of the lathe spindle. A hole should be drilled through the center of the plug large enough to receive the point of an ordinary wood screw and then counterbored to receive the tip of the revolution counter. Slots should then be sawed as indicated in the end of the plug which enters the spindle. To hold the plug firmly in place a wooden screw should then be inserted as shown and turned until the end of the plug expands and grips the inside of the spindle. The speed counter can be held in place by a small machine screw. The body of the counter will be kept from turning by gravity. When winding at high speeds, however, a weight should be attached to the counter to prevent its turning.

CABINET FOR FACTORY SERVICE

Relatively Inexpensive Switch Cabinet Used by Company to Insure Low First Cost

To reduce the investment required for factory customers to change over from steam-driven equipment to motor service, the Cumberland County Power & Light Company of Portland, Me., devised an inexpensive fuse, switch and meter cabinet which is illustrated herewith. The cabinet is built of galvanized-iron plate mounted on



INEXPENSIVE FUSE, SWITCH AND METER CABINET

1½-in. (38.1-mm.) by 3/16-in. (4.76-mm.) angle-iron framing and is equipped with four hinged front doors. Slate panels are provided at the back to carry the switches, fuses and meters. The over-all dimensions of the cabinet are 6 ft. (1.83 m.) by 7 ft. (2.13 m.) by 18 in. (46 cm.). The particular cabinet illustrated controls five induction motors aggregating 150 hp. in rating and provides space for three additional motor switches capable of handling a connected load of 75 hp. A smaller cabinet designed for accommodating the local shop-lighting fuses and switches is shown at the right. The cost of the power cabinet with switches arranged as at present, but with three more power circuit recording wattmeters added, will amount to about $220. These cabinets have been found particularly useful for serving motors which have been installed in shops where emergency service is required as well as in other installations where the first cost of more elaborate equipment would have appeared too large in the eyes of the factory owner.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Applications of Electric Light, Power and Heat

CONSUMER EXPENSES IN CITIES OF SMALL POPULATION

Data Published by Western Company Showing a Part of the Costs That Should Go to Make Up the Minimum Charge

The table herewith, which is taken from a recent issue of the *Au Sable News*, published by the Consumers' Power Company, Jackson, Mich., shows the expenses in twelve cities served by the same company which are directly and entirely attributable to consumer costs. Such costs should be a part of the minimum charge, according to the rulings of commissions, which have held that the minimum bill should cover consumer costs and fixed charges plus a charge for the actual service used. The items which go to make up consumers' costs in this table are: Setting and removing meters, repairs of services, repairs to customers' meters, inspection of customers' premises, customers' installations, salaries and expenses of meter indexers, salaries and expenses of accounting department, salaries and expenses of collection bureau, commercial office rent, commercial office supplies and expenses.

The table shows the average number of consumers in each city for the year and each city's percentage of the total. The table also shows the cost per consumer per year and per month and the percentage of the total cost in each city. It is interesting to observe the close relation between each city's percentage of total consumers and its percentage of consumer expenses. City "D," for instance, has 11.7 per cent of the consumers and incurred 11.58 per cent of the consumer expenses. The consumer cost per consumer per month is shown to be 28 cents. This figure compares rather favorably with similar costs recently brought out in establishing a minimum charge in a large city. The consumer cost per consumer per month there was about 33 cents.

CONSUMERS' EXPENSES IN TWELVE CITIES SERVED BY SAME COMPANY

Showing Cost Per Consumer Per Year and Per Cent of Total

CITY	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H"	"I"	"J"	"K"	"L"	Total
Number of Consumers	2,626	2,870	1,249	6,691	14,911	5,871	6,102	1,230	4,534	2,824	2,271	6,216	57,195
Percent of Total	4.59	5.01	2.18	11.70	26.07	10.26	10.67	2.15	7.93	4.59	3.97	10.88	100
Setting and Removing Meters	$ .23	$ .14	$ .35	$ .16	$ .14	$ .08	$ .20	$ .08	$ .19	$ .17	$ .23	$ .10	$ .15
Percent of Total	6.85	4.64	4.98	12.21	22.72	5.74	13.79	1.09	9.72	5.13	5.99	7.14	100
Repairs Services	.08	.06	.13	.12	.22	.18	.05	.006	.03	.05	.10	.04	.11
Percent of Total	3.22	3.77	2.17	11.38	47.70	15.80	4.25	.12	2.22	1.79	3.43	4.15	100
Repairs Customer's Meters	.64	.37	.44	.37	.59	.38	.44	.43	.70	.32	.52	.44	.49
Percent of Total	6.06	3.80	1.94	8.80	31.41	8.02	9.72	1.90	11.34	3.03	4.26	9.72	100
Inspection Customer's Premises	.20	.01	.10	.28	.15	.23	.23	.10	.15	.06	.14	.19	.17
Percent of Total	5.25	.04	1.27	18.60	21.70	13.38	14.07	1.27	6.82	1.78	3.28	12.54	100
Customer's Installation	.51	.23	.06	.33	.38	.42	.46	.07	.36	.07	.04	.30	.34
Percent of Total	6.95	3.45	.41	11.50	29.68	12.90	14.66	.45	8.62	.99	.41	9.98	100
Salaries and Exp. Meter Indexers	.25	.22	.15	.27	.22	.19	.21	.23	.19	.27	.16	.20	.22
Percent of Total	5.20	5.01	1.55	14.61	26.56	9.19	10.51	2.29	6.92	5.02	3.02	10.12	100
Salaries and Exp. Accounting Dept	.99	.70	1.01	.65	.82	.81	1.09	.72	.84	.59	1.15	.57	.81
Percent of Total	5.63	4.33	2.73	9.45	26.42	10.22	14.37	1.68	8.23	3.62	5.63	7.69	100
Salaries and Expense Collection Bureau	.46	.20	.34	.34	.28	.14	.25	.17	.18	.50	.58	.15	.26
Percent of Total	8.15	3.86	2.91	15.27	27.40	5.36	10.16	1.39	5.66	8.80	4.58	6.46	100
Commercial Office Rent	.89	.42	.63	.39	.43	.73	.29	.58	.32	.31	.46	.58	.46
Percent of Total	9.96	4.57	3.03	10.05	24.33	16.55	6.89	2.74	5.59	3.12	4.02	9.15	100
Commercial Office Supplies and Exp.	.60	.59	.50	.42	.24	.23	.35	.36	.30	.28	.84	.34	.35
Percent of Total	6.55	8.44	3.13	14.00	17.87	6.80	10.60	2.24	6.75	3.62	9.49	10.51	100
Total of Above Items	$4.87	$2.98	$3.74	$3.34	$3.48	$3.42	$3.60	$2.76	$3.28	$2.81	$3.87	$2.75	$3.38
Percent of Total	6.63	4.42	2.42	11.58	26.72	10.38	11.35	1.77	7.72	3.53	4.67	8.81	100
Cost per Consumer per Month	$ .405	$ .248	$ .311	$ .278	$ .288	$ .285	$ .300	$ .230	$ .273	$ .217	$ .338	$ .229	$ .281

EXPENSES DIRECTLY ATTRIBUTABLE TO CONSUMER COSTS

FREE FLOODLIGHTING TO IRRADIATE "OLD GLORY"

New Jersey Company Offers Energy Gratis to All Patrons Desiring to Employ It for Such Patriotic Purpose

Immediately on the declaration of war by the United States a patriotic scheme of floodlighting the American flag was conceived by a small New Jersey property, namely, the Commonwealth Electric Company of Summit, N. J. The company advertised that it would light free by means of floodlamps all American flags in the city if a requisition for such lighting was made. This

free supply of energy was for the period of war only, and it was stipulated that the equipment used should first be passed by the lighting company.

While the company must approve the type of reflector used, it does not demand that the reflector be purchased from it, although so far the reflectors have been purchased from the company, which sells them at the regular list price. Already there are seven installations, with more in sight, and all of them are used by men who will almost certainly find other employment for them after the war. In all, there are ten reflectors in use.

Each installation has an outside switch whereby the company's patrolman can turn on the lamps and the police department turn them off at midnight. The police department is employed to turn off the lamps at a rate of 25 cents per month per installation, which is paid by the owner of the flag.

While the company sells its equipment at retail, it makes the installation at cost price. The energy used by the floodlamps is carried on a separate account and deducted from the total so that it will not show up as line loss. The lamps are tapped from the secondaries of the line transformers.

COST OF CONSUMERS' SERVICE CONNECTIONS

Data on the Handling of This Difficult Task in the Territory of a Public Service Company Covering 100 Square Miles

BY WALTER E. BEATY

Since the territory served by the lines of the Union Gas & Electric Company of Cincinnati covers almost 100 square miles (259 hectares), handling service connections is difficult. Except in the downtown district the service work is done by crew with automobile trucks. The men who run the service lines also set the meters and make final connections. This method of handling the work has been found satisfactory in practice, and is thought to be more efficient than the plan which employs several sets of men on the job where the time lost in going from place to place is a large part of the day's work. One of the main troubles formerly encountered in operating under this plan was the damage to meters. The men either handled them carelessly or piled material on them in loading the trucks. All meters are now carried in light sheet-iron boxes which are padded inside. These fully protect the meters.

In the table, prepared some time ago, cost data are given on the expense of connecting service lines and meters. The total cost of operating a three-man gang, including the expense of a ½-ton (0.45-t.) truck, was $12.75 per day, or almost $1.40 per hour. It is also of interest to note in this connection that the average cost of labor to install the various types of services does not vary as much as the cost of material. In October, for instance, the cost of labor per service for the different types was: Two-wire, less than 100 ft. (30 m.) long, $1.25; two-wire, more than 100 ft. long, $1.30; three-wire, less than 100 ft. long, $1.22, and three-wire, more than 100 ft. long, $1.27. Taking the material costs for the same month on the same group of services, the results were as follows: Two-wire, less than 100 ft. long, $3.32; two-wire, more than 100 ft. long, $5.95; three-wire, less than 100 ft. long, $4.63, and three-wire, more than 100 ft. long, $7.68. These data indicate that while it costs more for material to install a three-wire service, the labor cost is practically the same as it is for a two-wire service.

The wire used in standard services is No. 8, triple-braid, weatherproof. This size was chosen because it was considered the smallest wire that had sufficient mechanical strength and at the same time was large enough to carry the average load in such installations. The average length of services is between 90 ft. and 100 ft. (27 m. to 30 m.). The maximum connected load allowed on a two-wire service is thirty-two 50-watt equivalents; that is, 1.6 kw. Lighting loads in excess of this amount must be placed on three-wire services. The potential drop in the average service lines, therefore, would not be over 2 per cent with all lamps operating.

COST OF SERVICE CONNECTIONS AT CINCINNATI

Month	Feet of Wire Strung	Price of Wire per Pound in Cents		Number of Services	Average Feet per Service	Average Cost per Service	Average Cost per Wire, Foot
April	25,406	0.185	Two-wire services under 100 ft.	69	128	2.65	0.02
			Two-wire services over 100 ft.	24	252	3.75	0.01485
			Three-wire services under 100 ft.	30	218	3.82	0.01748
			Three-wire services over 100 ft.	8	383	8.36	0.02134
Total and total average				131	187	3.47	0.015
August	34,681	0.2532	Two-wire services under 100 ft.	84	130	3.94	0.0803
			Two-wire services over 100 ft.	37	253	5.50	0.0217
			Three-wir eservices under 100 ft.	48	204	5.05	0.0247
			Three-wire services over 100 ft.	12	384	8.62	0.0224
Total and total average				181	191	4.67	0.244
October	37,363	0.2725	Two-wire services under 100 ft.	130	130	3.94	0.0303
			Two-wire services over 100 ft.	27	253	5.50	0.0217
			Three-wire services under 100 ft.	48	204	5.05	0.0247
			Three-wire services over 100 ft.	10	384	8.62	0.0224
Total and total average				215	173	4.60	0.0264

Local conditions have important bearings on the service costs. The lines, for instance, of the central station at Cincinnati are on the main streets. Alleys are uncommon and could not be used for distribution circuits because they lack continuity of layout. The typical service, therefore, runs from a pole in front of the house across the lawn to the attic or second story of the building. Over 95 per cent of services installed in the past few years are overhead and are for residences.

RANGE SERVICE BROADENS CENTRAL STATION PEAK

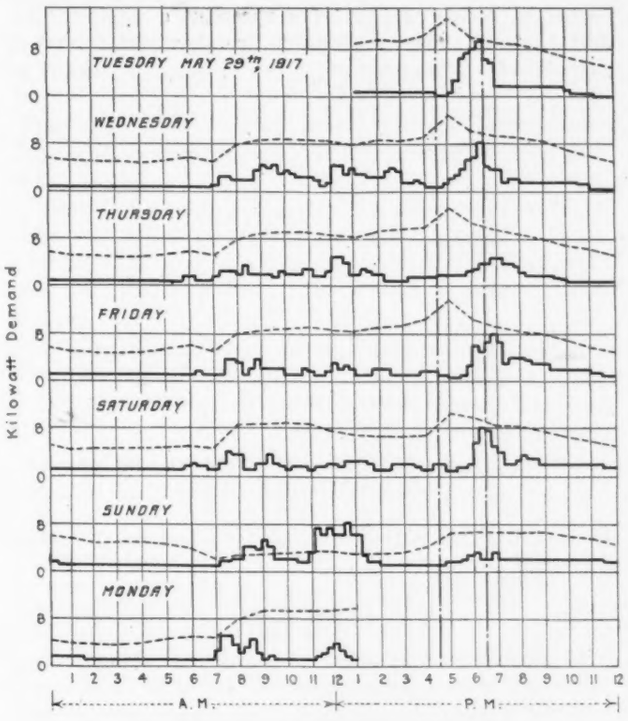
Figures Obtained from Twelve-Apartment Building at Indianapolis Show Average Monthly Requirement for Cooking and Lighting

Data on the use of electrical energy in an all-electric apartment house in Indianapolis brought to light rather unusual relations between the demand and connected load, between the apartment house peak and the central station peak, and at the same time indicated an unexpected low energy consumption per apartment.

The apartment building in question consists of twelve five-room apartments. The equipment of each apartment consists of the following:

One electric range	4,300 watts
Fourteen forty-watt lamps	560 watts
One percolator, One iron, One toaster	1,650 watts
Total connected load per apartment	6,510 watts
Total connected load for twelve apartments	78,120 watts

In addition to this the realty company owning the building has connected twenty hall and basement lamps,



DEMAND CURVES OF ELECTRIC RANGES

aggregating 500 watts, and two vacuum cleaners rated at 0.5 hp. each, making an additional connected load of 746 watts. The total connected apartment house load is therefore 78,866 watts. The amount of energy consumed over a period of practically seven months ended in May, 1917, was 7056 kw.-hr.

During that period there was the equivalent of seven flats vacant for one month, so that the total occupancy amounted to seventy-seven "flat months" in that period. The average consumption per apartment per month was therefore 91.63 kw.-hr. This total, of course, includes the energy used for hall and basement lighting and for the vacuum cleaners. Deducting 120 kw.-hr. for this service shows that it required an average of 81.63 kw.-hr. per apartment per month for cooking and lighting in this building.

The results of a demand test covering Saturday (a short day), Sunday (usually a heavier day) and Monday as well as Thursday and Friday (ordinary days), are shown on the curves herewith. These curves indicate that the maximum demand from the 78.86-kw. installation was 10 kw., which occurred between 5.45 and 6.30 p. m. on May 29, 1917. These data indicate a maximum demand factor of 12.7 per cent and a load factor based on demand of 15.1 per cent.

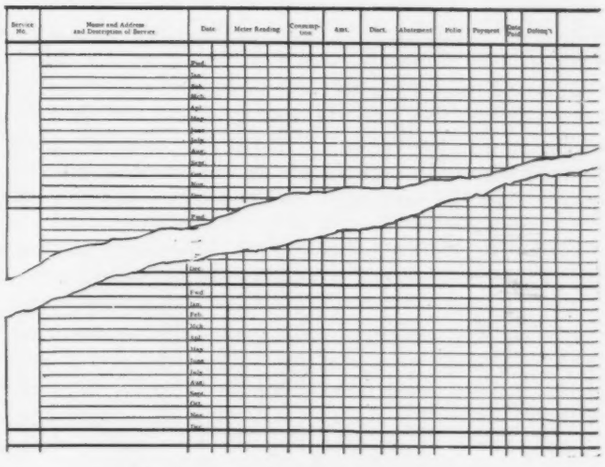
In the curves the heavy black lines indicate the daily conditions in the apartment building, including all electric service as reported by a graphic wattmeter. The lighter curve, which is superimposed without taking account of its kilowatt value, shows the relation between the occurrence of the apartment house peak and the system peak in the week of heaviest demand during 1916. This system load curve indicates that the peak of the Merchants' Heat & Light Company, from which the service was taken, comes between 4.30 and 6.30 p. m. The fact that the evening range load comes at a somewhat later time indicates a broadening of the peak rather than a definite increase.

In analyzing these curves R. A. MacGregor, sales manager of the Merchants' Heat & Light Company, called particular attention to the demand factor, the apparent broadening effect of the electric range load on the system peak, the satisfactory load factor and the low average energy consumption per apartment per month. With the rate now in effect at Indianapolis it is possible for a residence customer to purchase the 92 kw.-hr. for cooking, lighting, sweeping and ironing for $3.58 per month.

ACCOUNTING METHODS OF GREAT CONVENIENCE

New Jersey Companies Keep Monthly History of All Accounts, with the Necessary Data for Billing Customers

There is shown in the accompanying illustration a page from one of the customers' accounts books of two affiliated New Jersey companies that operate in very small communities, the Lakewood & Coast Electric Company, Point Pleasant, N. J., and the Commonwealth Electric Company, Summit, N. J. Each page contains space for five customers. Each record contains the monthly history of the account to date and gives all the data necessary for billing. One of the features of this method is the posting of delinquent accounts. At the extreme right is found the total delinquent amount owing at any one time, and by tracing this line up it



PAGE FROM CUSTOMERS' ACCOUNTS BOOK

can easily be seen whether or not the account is one month or two months old or still older.

It is understood that slight changes will be made in this form with the beginning of the new year. The changes will be almost entirely to make room for additional information regarding the customer's connected load.

ADVANCE IN TECHNICAL THEORY AND PRACTICE

Including a Digest of Important Articles Appearing in the Scientific and Engineering Press of the World

VERSATILE FUNCTIONS OF THE PLIOTRON OSCILLATOR

It Can Be Employed Readily for the Production of Large Currents or High Potential at High Frequencies

THE pliotron is an unusually versatile device. In the *General Electric Review* for August, 1917, William C. White has an article which, while not dwelling on this point, shows how a single pliotron can be employed, on the one hand, to obtain 25 amp. at 100,000 to 1,000,000 cycles and, on the other hand, 12,000 volts at 100,000 cycles. The device, it is pointed out, is proving itself very useful in calibrating, testing, etc., where a relatively small amount of electrical energy is sufficient. In a resonance circuit the current will rise until the losses become equal to the input energy. With practical circuits the lower limit of power factor obtainable is about one-half of 1 per cent, unless unusual precautions are taken. This means that the maximum resonance current produced is about 200 times the value of the true energy current fed into the resonance circuit. Therefore, where large currents are desired from a small quantity of energy, the total volt-amperes of the circuit must be kept small, and this condition requires that for such a resonance circuit a large capacity and small inductance must be used. The diagram of an arrangement to produce currents of from 10 amp. to 25 amp. from one pliotron tube at frequencies between 100,000 cycles and 1,000,000 cycles is shown in Fig. 1.

There is another principle which must be kept in mind. If the amount of electrical energy which can be furnished by a certain source is limited by the definite amount of primary power available, or by the losses in transmission, it is important so to adjust the resistance of the load to the voltage of the supply that the energy is most economically utilized. In the present case, this means that the resistance of the heavy-current circuit

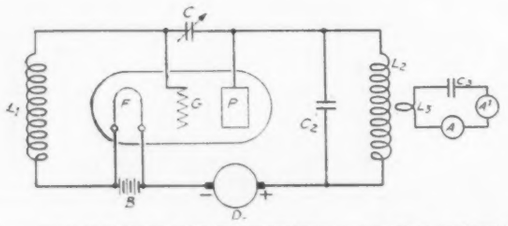


FIG. 1—ARRANGEMENT FOR PRODUCTION OF LARGE CURRENT AT HIGH FREQUENCY

must be given the apparent value most suitable for insertion in the pliotron circuit. This adjustment of apparent resistance is accomplished by electromagnetic coupling or transformer action.

Suppose it is desired to calibrate a hot-wire ammeter by means of direct comparison with a standard. These two ammeters are represented by A and A_1 and are connected in series as part of a resonant circuit, the inductance and capacity of which are shown at L_3 and C_3 respectively. The product of the values of L_3 and C_3 to

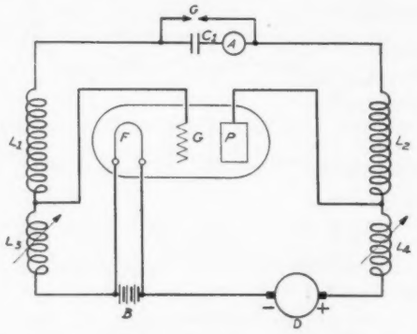


FIG. 2—PLIOTRON OSCILLATOR ARRANGEMENT FOR THE PRODUCTION OF HIGH VOLTAGES

be used for any particular case is found by the usual resonance formula:

$$f = \frac{1}{2\pi\sqrt{LC}}$$

As mentioned in a previous paragraph, a low power-factor and volt-ampere product is desirable; and therefore the inductance value of L_3 is made the minimum possible, consisting usually of only one or two turns of heavy conductor. With the range of frequencies specified, this gives values for C_3 of the order of about 0.1 microfarad. In this heavy-current circuit it is of course very necessary to use condensers of low energy loss and to reduce the ohmic resistance of the conductors to a minimum.

The inductance L_3 obtains energy by electromagnetic coupling from the coil L_2 which is located in the plate circuit of the pliotron.

By means of an adjustment of the values of L_1, L_2 and C_1, the pliotron system can be made to set up a high-frequency current corresponding in period to the tuned heavy-current circuit.

Owing to the relative values of L_2 and L_3, the apparent resistance in the plate circuit of the heavy-current load circuit is greatly multiplied, but still is not of a sufficiently high value to absorb all the available energy. To further increase this apparent resistance, a variable capacity, C_2 is shunted about the inductance L_2. Then, by simultaneous variation of these two factors, the apparent resistance of the load can be adjusted to give the largest energy output available.

The heavy-current output is dependent upon the voltage of the direct-current source D, a useful range being between 200 and 750 volts.

Pliotrons may be operated in parallel to produce a load current larger than that obtainable from one tube.

In order to cause the production of high voltage in a resonance circuit, the conditions are almost the reverse of those in a heavy-current circuit; that is, with a fixed value of inductance and capacity to give the desired frequency, the capacity must be small and the inductance large, relatively speaking. There is a practical limit, however, to this increasing of inductance and lowering of capacity, and it is reached when the distributed capacity effect in the inductance becomes comparable to the capacity of the condenser used for resonance. A pliotron oscillator arrangement for the production of high voltages is shown in Fig. 2.

Generators, Motors and Transformers

Functioning of Repulsion Motors.—L. C. BARBILLION.—The author gives a new diagrammatic scheme for the performance of repulsion motors. The method that he follows would apply equally to all alternating-current motors of the collecting-ring type and makes it possible to obtain diagrams for the numerous varieties of such motors that are in use.—*Revue Gén. de l'Elec.*, June 23, 1917.

Heating of Dynamo-Electric Machines with Various Loads and at Different Speeds.—MAGNUS MACLEAN and D. J. MACKELLAR.—The series of tests described in this paper were carried out at the Royal Technical College,

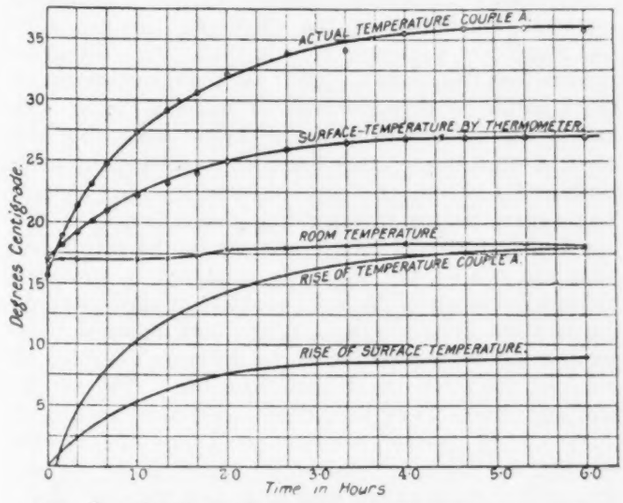


FIG. 3—RESULT OF TEST FOR TEMPERATURE RISE WITH GENERATORS RUNNING LIGHT

Glasgow, with the primary object of obtaining information as to the effect of armature current and armature peripheral velocity on the temperature rise of the various parts of direct-current machines. Such an investigation even for a single machine is necessarily long, and in the present instance the tests have been perforce confined to the determination of temperatures and temperature rises of a field coil of a direct-current machine of the small open-type class, run at various speeds and under different load conditions, in some cases as a motor, in others as a generator. The results have been where possible compared with those previously obtained for a larger machine and also with the published results of other observers. The machine on which the tests were performed is a rotary converter having an output of 25 kw. when driven as a direct-current generator at 500 volts. This machine is mounted on a single bed-plate with a similar machine, the two machines being mechanically connected by a flexible coupling. The second machine was employed as a driving motor in those cases in which the machine under test was run as a generator. Each machine has a sheet-iron fan mounted on the slip-ring end of the armature. The fans have each a diameter of 480 mm. There are sixty-four straight radial blades having a depth of 60 mm. and a width of 25 mm. The external diameter of the armature is 292 mm. The machines are designed to run at 1500 r.p.m. at 500 volts direct current. In starting a test initial readings were taken of the room temperature and of the galvanometer deflection for each of the thermo-couples. The field current was switched on, and simultaneous readings of the field-coil ammeter and voltmeter were taken. When the machine was run as a motor it was necessary for starting purposes to have maximum field current, but as soon as the starter handle had been moved to the last contact the field-coil current was as rapidly as possible adjusted to the value required for the test. The field-coil current was maintained as nearly as possible at the value throughout the test. In the early part of each test sets of readings were taken at frequent intervals. As the temperature changes became less rapid these intervals were extended. Each set of readings consisted of (1) armature current, (2) armature volts, (3) field-coil current, (4) field-coil volts, (5) speed of machine in r.p.m., (6) galvanometer deflections for thermo-couples, (7) room temperature by thermometer, (8) surface temperature by thermometer.—London *Electrician*, July 6, 1917.

Lamps and Lighting

Tungsten Filaments.—W. BÖTTGER.—Paper read before the Deutsche Bunsen Gesellschaft. Description of the process of the firm of Julius Pintsch, due to O. Schaller and Orbig. Powdered tungsten, 2 per cent of thoria and some binding agent are kneaded into a paste from which threads are squirted. These threads are preheated and then rapidly raised to higher temperature by being passed through a hot zone at 2400 deg. or 2600 deg. C. at a rate which is smaller than the velocity of crystallization. The resulting wire, only a few hundredths of a millimeter in diameter and octagonal rather than circular in section, consists of crystals many meters in length.—*Phys. Zeits.*, March 1, 1917.

The Purple Color of Lamp Globes.—M. LUCKIESH.—The presence of the often noted purplish tint of lamp globes has been shown to be due to manganese. This article calls attention to the fact that the introducing of manganese to neutralize the greenish tint due to slight quantities of iron oxide may reduce the light transmission factor from 10 to 25 and even 55 per cent, there having been found specimens having 85 per cent reduction. The recommendation is therefore made that in outdoor illumination glassware the manganese be omitted from the formula.—*General Elec. Review*, August, 1917.

Artificial Illumination of Factories.—Conclusion of the discussion of this subject. The relative importance of illumination in various parts of a factory is considered, the structure being for this purpose divided into three sections—(1) the floors or portions of floors on which operatives work; (2) the passages, staircases, vestibules and other places in which operatives circu-

late but do not work, and (3) the courtyards and their accessories. The illumination of the workrooms is classified under four headings: (1) General illumination, in which the light produced is uniform everywhere; (2) general local illumination, in which the light produced is approximately uniform in one or more regions of the place in question; (3) local illumination, in which every light source has for its object the illumination of a part of a machine without reference to the action of any other light source; (4) general illumination combined with local illumination. The report of an Italian commission on factory lighting is summarized in this article. One conclusion arrived at is that, except as regards cost of installation, it is inadvisable to draw distinctions between direct, indirect and semi-indirect systems of lighting. The value of the illumination is independent of the nature of the light.—*Rivista Tecnica d'Elettricita*, June 14, 1917.

Generation, Transmission and Distribution

Corona Effect and Rectification of Current in Hydrogen.—An article describing new comparative experiments with the phenomenon of corona in the air and in hydrogen at different pressures. The apparatus employed was a reproduction of Ryan's arrangement, in which a wire and a cylinder are coaxial. For the same gas the effects observed varied with the polarity of the wire and led to characteristics distinctly different. There was no relation found between relative characteristics with two different gases. A method by which corona in hydrogen may be used for the rectification of current is indicated by the author.—*Revue Gén. de l'Elec.*, July 7, 1917.

Sphere Gaps for Lightning Arresters.—V. E. GOODWIN.—The aluminum or electrolytic type of lightning arrester is recognized as being the most efficient type of arrester by virtue of its high discharge rate, large heat-absorbing capacity and its ability to discharge lightning disturbances without interfering with line conditions, owing to the quick action of the aluminum cell. The addition of sphere gaps to the arrester for alternating-current circuits increases the speed with which the arrester discharges lightning impulses and consequently further increases the efficiency of the arrester. The description of the application of the sphere gap given in the article therefore records a marked improvement in the art of protecting electrical apparatus against lightning.—*General Elec. Review*, August, 1917.

Electrochemistry and Batteries

Charging Storage Batteries of Electric Vehicles.—J. J. KLINE.—The construction of the storage cell and its chemical, thermal and electrical actions on charge and discharge are briefly reviewed in the introduction of this article, in order to make more readily intelligible the description and discussion of the constant-potential system of charging which form a large part of the article. After a very complete treatment of the constant-potential system, there appear descriptions of the charging apparatus, including switchboards, automatic switches, individual charging sets, automatic charger, etc.—*General Elec. Review*, August, 1917.

Units, Measurements and Instruments

A New Meter for High-Voltage Energy.—P. F. DUFOUR.—A description of a high-tension electricity meter patented by the author which has the distinguishing feature of possessing only low-tension apparatus without a transformer, the customer's transformer being made to fill the rôle of measuring transformer. This appliance, on account of being less costly than those generally in use, will permit the installation of double meters, against which the expense has always operated, despite their advantages.—*Revue Gén. de l'Elec.*, June 30, 1917.

Installations, Systems and Appliances

The Use of Low-Grade Mineral Fuels and the Status of Powdered Coal.—F. PARKMAN COFFIN.—In this first installment of the series the distribution of the coal deposits in North America is described, and attention is called to the fact that certain sections of the continent at a distance from the coal mines have large undeveloped deposits of low-grade fuel. Reference is made to the other low grades of coal which are produced as by-products of mining. The solid mineral fuels are treated in the following order: peat, lignite, bituminous coal and anthracite. The methods of burning each of these fuels are reviewed—viz., burning on grates, in gas producers and in pulverized form. The relative advantages of each method are discussed in detail.—*General Elec. Review*, August, 1917.

Miscellaneous

Refractory Materials.—Report of the refractory materials committee of the (British) Institution of Gas Engineers, presented June 5, 1917. The committee reports that the necessary plant for the investigation of the question of refractoriness of material under load and of the differences in size of bricks when cold and when at high temperature has been completed for some time and research in these respects has commenced. The apparatus for investigating the influence of the fine flue dust carried into the setting on the refractoriness and life of the materials employed is now also practically complete. A large quantity of clay, amounting to about 20 tons (18.1 t.), has been obtained from six sources, representative of the different varieties of material found in the United Kingdom. The hot to cold measurements of the bricks collected as typical of those on the market are completed, and the results obtained are given in detail in the report of Dr. Mellor. The results obtained are such as to cast some doubt on previous measurements of the coefficient of thermal expansion of firebricks and related materials at high temperatures, as the true thermal expansion is obscured by effects due to the after-expansion or after-contraction of the firebricks which is taking place while the bricks are being measured. The work carried out by Dr. Mellor in this respect demonstrates the importance of taking into account the continued alteration in the character of bricks under prolonged or repeated heating. A number of measurements of the after-contraction or after-expansion of firebricks have been made to test the conditions laid down in this respect in the standard specification, and the results obtained are given in Dr. Mellor's report. The general conclusion derived from this series of tests is that the tendency is for ordinary silica bricks to give a less expansion and firebricks of fireclay to give a greater contraction in the reducing than in the oxidizing atmosphere.—London *Engineering*, June 15, 1917.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

APPLICATION OF MISSOURI UTILITY ASSOCIATION DENIED

Commission Holds that Utilities Must Apply Individually for Increases in Rates Before Relief Can Be Granted

On Tuesday, Aug. 7, the Public Service Commission of the State of Missouri, sitting in Jefferson City, denied the application of the Missouri Association of Public Utilities for a blanket order whereby that association would have been empowered to increase the rates of each one of its 303 member companies. In handing down its decision the commission held that a specific case should be presented by each one of the 303 utilities involved. The commission contends that it has not the right to authorize an indiscriminate increase in rates of each of a number of individual companies on the motion of an association of which these utilities are members and asserts that it has never attempted to establish a rate without first knowing the valuation of the property involved. It therefore follows that each of the 303 member companies must make individual application unless the association can show the commission that conditions in a number of cities are identical and that a uniform rate exists in these cities.

The petition of the association included tabulated data showing that the price of coal increased from 50 cents a ton at the mines in April, 1913, to $2 per ton in May, 1917. The petition also set forth the fact that the maximum prices for Illinois coal fixed by the government are $2.75 for mine-run and $3.50 for domestic.

As regards the prices of general supplies and labor, the petition set forth averages obtained from seventy-six answers to a circular letter sent to utility companies in Missouri. A tabulation of these reports showed the following advances in prices during the last five years: Steam coal, 49 per cent; gas coal, 50.8 per cent; coke, 66.6 per cent; wood, 13.8 per cent; fuel oil, 72.3 per cent; gas oil, 97.6 per cent; lubricating oil, 24.4 per cent; gasoline, 71.9 per cent; office help, 32.3 per cent; plant labor, 25.4 per cent, and freight, 16.2 per cent. This makes an average increase in the cost of these items of 47.4 per cent. Coal purchased in the open market because of expiring contracts or failure to obtain supply on existing contracts resulted in an advance of 119.1 per cent. Cases of this character are not taken into account, however, in the above tabulation.

Data collected from the discount sheets of supply houses show advances in prices during the last three years as follows: Class A, malleable fittings, 78.5 per cent; cast-iron fittings, 155.5 per cent; brass valves (regrinding), 78.3 per cent; straight-way valves, cast iron, 83.8 per cent; 4-in. (10.16-cm.) boiler tubes, 226.4 per cent; 2-in. (5.08-cm.) wrought-iron black pipe, 125.7 per cent; 6-in. (15.24-cm.) well casing, 75 per cent; 6-in. to 12-in. (15.24-cm. to 30.48-cm.) cast-iron water main, class B, 218.1 per cent; 4-in. (10.16-cm.) cast-iron water main, class B, 236.3 per cent; 4-in. (10.16-cm.) hydrants (standard), 32.2 per cent; pig lead, 188.8 per cent; weatherproof copper wire, 131.4 per cent; pole-line hardware, 110 to 144.4 per cent. The average advance in this class of items amounted to 136.4 per cent.

The petition asked the commission to issue a general order permitting utilities to attach riders to bills rendered on present schedules to cover these unavoidable increases in operating expenses during the present crisis. The amount of relief desired by the several water, gas and electric utilities composing the association was presented to the commission at the time of the hearing on the application by a representative of each utility.

PRAISE FOR COMMITTEE ON GAS AND ELECTRIC SERVICE

Quartermaster's Department Gives Recognition to Its Work in Getting Electric Service Promptly for the Cantonments

The National Committee on Gas and Electric Service has been actively co-operating with the Advisory Commission of the Council of National Defense and with a number of the departments of the government that are actively engaged in various measures for the prosecution of the war. The committee has been able through its close touch with the gas and electric utility companies to be of special service to the Quartermaster General's Department in connection with the troop cantonments, and it has received the attached letter from Col. I. W. Littell, expressing appreciation of its services:

WAR DEPARTMENT
Office of the Quartermaster General of the Army
WASHINGTON, July 31, 1917.

From: Officer in charge of cantonment construction.
To: National Committee on Gas and Electric Service, Munsey Building, Washington, D. C.
Subject: Service rendered by your committee in connection with cantonments.

1. This office wishes to express its appreciation of the very valuable service rendered by your committee in connection with solving the problem of obtaining electric power and gas supply where required for the cantonments for the National Army. Due to the information furnished by your committee, a large amount of investment in temporary power plants has been saved to the government.

2. Time did not permit using your services in connection with the National Guard camps in the same manner as they were used in connection with the National Army cantonments, but even under these circumstances your services have proved very valuable in connection with the National Guard work.

3. This office also wishes to express its appreciation of the uniform courtesy and efficiency of your local representatives.

By authority of the Secretary of War:

I. W. LITTELL,
Colonel, Quartermaster Corps, in Charge of Cantonment Construction.

TO INCORPORATE AMERICAN ACADEMY OF ENGINEERS

Senate Committee on Judiciary Presents Bill with This Object to Congress, and Favorable Action Is Taken Upon It

On Aug. 3 the Senate, in committee of the whole, considered the bill incorporating the American Academy of Engineers.

The incorporation of the American Academy of Engineers was earnestly recommended by Gen. George W. Goethals, Dr. S. W. Stratton, director of the Bureau of Standards, and many other expert engineers and scientists. The measure provides for the establishment of a body of representative engineers upon whom the government may call for advice in time of need. The members named in the bill as the incorporators are well known as leaders in their respective professions. It was generally recognized that the body would be of great service to the government at all times in an advisory capacity as regards its engineering work both in the military and the civic departments. There are at least 200,000 engineers in the United States who are interested in securing a plan for united action in the most positive and effective way, and the incorporation of the American Academy of Engineers paves the way for such action.

OBJECTS OF THE ACADEMY

The objects of the proposed organization are first to render loyal and effective service to the government of the United States as far as lies in its power, and second to advance in every legitimate manner the interests and welfare of the engineering profession in all its numerous branches. The establishment of such an academy has been under consideration for eight years.

The bill provides that the incorporators and first members of the American Academy of Engineers, as given below, and their associates and successors duly chosen be and they are hereby constituted and declared to be a body corporate of the District of Columbia by the name of the American Academy of Engineers. It continues:

Sec. 2. That the purposes of this corporation are and shall be the furtherance of the interests of engineering, industrial technology and applied science.

Sec. 3. That the American Academy of Engineers shall consist of not more than 200 regular members, and the said corporation hereby constituted shall have power to adopt a constitution and to make all by-laws, rules and regulations not inconsistent with law that may be necessary or expedient in order to accomplish the purposes of its creation; to fill all vacancies created by death, resignation or otherwise; to provide for the election of foreign and domestic members and the division of such members into classes; to adopt a seal, and to do all other matters needful or usual in such institutions.

Sec. 4. That the American Academy of Engineers shall hold an annual meeting at such place in the United States as may be designated and shall make an annual report to the Congress, to be filed with the librarian of Congress.

Sec. 5. That the American Academy of Engineers shall, whenever called upon by any department or establishment of the government, investigate, examine, experiment and report upon any subject of engineering science or art, the actual expenses of such investigations, examinations, experiments and reports to be paid from appropriations which may be made for the purpose; but neither the academy as a body nor any of its committees shall receive any compensation whatever for any service to the government of the United States.

Sec. 6. That the American Academy of Engineers be and the same is hereby authorized and empowered to receive by devise, bequest, donation or otherwise, either real or personal property, to an amount not exceeding $1,000,000 in the aggregate, and to hold the same absolutely or in trust, and to invest, reinvest, manage and apply the said property and the income arising therefrom in furtherance of the objects of its creation.

Sec. 7. That the right to alter, amend or repeal this act is hereby expressly reserved.

The incorporators and first members are as follows:

John W. Alvord, Chicago, consulting civil engineer.

Dr. Edward G. Acheson, Niagara Falls, past-president American Electrochemical Society.

Thomas E. Brown, New York, consulting engineer Otis Elevator Company.

Dr. Louis Bell, Boston, past-president Illuminating Engineering Society.

Dr. L. H. Baekeland, New York, past-president American Electrochemical Society, past-president American Institute of Chemical Engineers.

Dr. C. F. Chandler, New York, past-president American Chemical Society.

John F. Coleman, New Orleans, consulting civil engineer.

Howard E. Coffin, Detroit, vice-president and chief engineer Hudson Motor Car Company, member Naval Consulting Board.

Dr. John J. Carty, New York, chief engineer American Telephone & Telegraph Company, past-president American Institute of Electrical Engineers.

Dr. Mortimer E. Cooley, Ann Arbor, professor at University of Michigan.

Prof. William F. Durand, Stanford University, California, naval architect and marine engineer.

Col. Gustave J. Fiebeger, West Point, professor of engineering at West Point.

Gen. George W. Goethals, New York, consulting engineer.

Dr. W. F. M. Goss, Urbana, Ill., past-president American Society of Mechanical Engineers.

Carl E. Grunsky, San Francisco, consulting civil engineer.

Admiral Robert S. Griffin, Washington, D. C., engineer-in-chief, U. S. N.

Dr. Carl Hering, Philadelphia, past-president American Electrochemical Society, past-president American Institute of Electrical Engineers.

Clemens Herschel, New York, past-president American Society of Civil Engineers.

Gen. H. F. Hodges, Washington, D. C., brigadier general U. S. A.

Dr. Henry M. Howe, New York, past-president American Institute of Mining Engineers, past-president American Society for Testing Materials, past-president International Association for Testing Materials.

Dr. John Hays Hammond, New York, past-president American Institute Mining Engineers.

Herbert C. Hoover, New York, honorary member American Institute of Mining Engineers, chairman Commission for Relief in Belgium.

Dr. Alexander C. Humphreys, New York, president Stevens Institute of Technology, past-president American Society of Mechanical Engineers.

Hennen Jennings, Washington, D. C., consulting mining engineer.

Dr. Julian Kennedy, Pittsburgh, Pa., designer of iron and steel works.

Hunter McDonald, Nashville, Tenn., past-president American Society of Civil Engineers.

Dr. C. O. Mailloux, New York, past-president American Institute of Electrical Engineers.

Charles T. Main, Boston, consulting mechanical engineer.

Bruno V. Nordberg, Milwaukee, president and chief engineer Nordberg Manufacturing Company.

Dr. William H. Nichols, New York, president General Chemical Company, past-president American Chemical Society.

Dr. William Barclay Parsons, New York, consulting civil engineer.

Corydon T. Purdy, New York, consulting engineer, expert in steel building construction.

Dr. M. I. Pupin, New York, member National Academy of Science, professor at Columbia University.

Charles F. Rand, New York, past-president American Institute of Mining Engineers.

Dr. Rossiter W. Raymond, New York, founder American Institute of Mining Engineers.

E. W. Rice, Jr., Schenectady, president General Electric Company, president-elect American Institute of Electrical Engineers.

Dr. S. W. Stratton, Washington, D. C., director of the Bureau of Standards.

Dr. George F. Swain, Cambridge, Mass., consulting civil engineer, professor at Harvard, past-president American Society of Civil Engineers.

E. Gybbon Spilsbury, New York, past-president American Institute of Mining Engineers.

Dr. Ambrose Swasey, Cleveland, Ohio, past-president American Society of Mechanical Engineers.

Frank J. Sprague, New York, past-president American Institute of Electrical Engineers.

Prof. A. N. Talbot, Urbana, Ill., past-president Society for Promotion of Engineering Education.

Stevenson Taylor, New York, president Society of Naval Architects and Marine Engineers.

Benjamin B. Thayer, New York, past-president American Institute of Mining Engineers.

Dr. Elihu Thomson, Lynn, Mass., member National Academy of Science, past-president American Institute of Electrical Engineers.

David W. Taylor, Washington, D. C., chief constructor U. S. N.

Prof. F. E. Turneaure, Madison, Wis., professor at University of Wisconsin.

Dr. M. C. Whitaker, New York, consulting chemical engineer.

Dr. J. A. L. Waddell, Kansas City, consulting civil engineer.

Dr. John F. Wallace, New York, past-president American Society of Civil Engineers, past-president Western Society of Engineers.

REASONS FOR NATIONAL CHARTER

Among the more important supplications made to Congress for the speedy enactment of the law providing for the incorporation of the American Academy of Engineers as a war measure was the following letter from Dr. C. O. Mailloux:

I should like to urge the importance and desirability of the Senate and Congress of the United States giving a national charter to the American Academy of Engineers at the earliest date possible. Besides the reasons of professional, national and civic character which amply justify the formation of the American Academy of Engineers, and which will probably be urged in letters addressed to you by other engineers on this subject, there are other reasons which make the movement extremely opportune at the present time. While I was in France last fall with the American Industrial Commission to France, of which I was a member, I had occasion several times to speak of this matter to many men prominent in engineering, applied science and technology, including members of the French Académie des Sciences. Many compliments were paid to the American engineering profession for its foresight and its initiative in having inaugurated a movement for the creation of an academy of engineers. The fact was recognized and was stated by them, in so many words, that the time has come when academies of engineers are necessary for the further and fuller development and evolution of the engineering profession as a factor in human progress. I was informed that, notwithstanding the fact that France already has the greatest academy of sciences in the world, the need has been recognized for something more.

The French government has since the war began created a new academy called the Academy of Agriculture by a special decree of President Poincaré, issued under date of Feb. 23, 1915, and countersigned by the Minister of Agriculture. This academy succeeds, and is based upon, the National Agricultural Society of France, founded in 1761. In the last two years efforts have been made to constitute in France a federation of engineers, architects and technologists with the idea of securing a better co-ordination of and co-operation between the different branches of applied science. Strange, but very important to note, a man like my friend Professor Blondel, the distinguished electrical engineer and scientist, who is himself a member of the Académie des Sciences, and consequently is a member of the Institut de France, was one of the very first to recognize the fact that there is still something lacking in France to enable the French nation and government to derive the fullest benefit and highest efficiency from the co-operation of technical men. He expressed to me the fervent hope that the American academy would soon be completely launched and established, because he fully believed that the example would be at once followed by the men interested in and connected with engineering and applied science in France. He expressed wonder that this happy idea, which he characterizes as an inspiration, had not been carried into execution long ago, especially in view of the fact that engineering and the work of engineers have assumed so much importance in modern life and in present-day activities, in warfare as well as in industry and commerce. A prominent French engineer told me that he wished that the idea of establishing a national academy of engineers had been thought of in France first instead of in America. However, under the circumstances, as France could not be the first, it would rather play second and come after America than after any other nation. He added laconically that there was one nation that might have been first, and which it would have been impossible for them to follow, as a matter of self-respect and dignity. In France the creation of an academy of engineers is regarded as a war measure of considerable importance, and seeing that the example is being set by America, France will be sure to follow it promptly and enthusiastically. A letter received from M. Blondel, under date of May 25, reiterates his great interest in the movement to establish the American Academy of Engineers, and congratulates American engineers on having organized that academy.

The preceding notes show that the men of the élite in engineering and applied science in France have the highest opinion of the American Academy of Engineers, and realize that its creation is fully justified. Their indorsement alone, in my opinion, constitutes a strong plea in favor of the prompt passage of the bills introduced in the Senate and the House of Representatives to incorporate that academy. I need not dwell upon the numerous other reasons related to the benefits which the profession of engineering in general and the nation as a whole can and will undoubtedly derive from the American Academy of Engineers. In France academies can be created by presidential decree on the recommendation of one of the ministers. I sincerely hope that the Senate and House of Representatives will not delay in taking the action desired by the charter members of the American Academy of Engineers, so that the said academy may not be deprived of the credit and satisfaction of having been the first academy of engineers to receive official sanction as a national academy of engineers.

DEFINITE RATE INCREASE BETTER THAN COAL CLAUSE

Illinois Commission in Rockford Case Disapproves Coal Clause Method, but Opens Way to Meet Higher Costs

A preliminary decision has been rendered by the Illinois Public Utilities Commission in the increased power rate case of the Rockford Electric Company, a subsidiary of the American Gas & Electric Company, which was reported in the ELECTRICAL WORLD for June 16, 1917, page 1151. The commission disapproves the coal-clause plan of raising rates, but indicates clearly that the higher cost of operation calls for an advance in power rates by other methods.

It was acknowledged by the commission that the tes-

timony showed decided increase in fuel cost. The statute provides that rates shall reimburse the company for cost. Increased cost should be reflected in increased rates. Discussing the question of what classes of consumers are most affected, the commission shows that coal cost is a larger proportion of total cost for power consumers than for other users. Power users would find the same conditions if they generated their own energy; lighting consumers could obtain other forms of energy for light.

The commission announced that it did not wish to subscribe *in toto* to the representations of the company, but the case demanded serious consideration. The principle involved was much broader than the particular issue raised. Copper might, for instance, furnish the basis for a similar case. Under the plan suggested of basing power rates on average coal cost, automatic increases would be made by the utility. The commission would have only bare statements as to coal cost.

The record indicated, the commission held, that the company was entitled to an increase in power rates, based on higher cost of operation. As the commission, however, does not believe rates should vary, the rate schedules should be made permanent schedules.

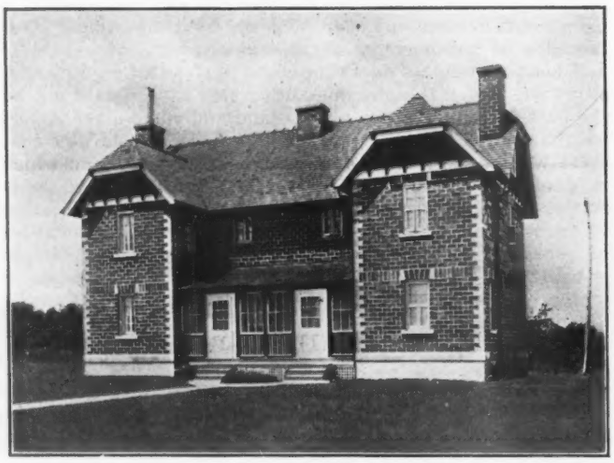
In effect, the conclusion of the commission was that if the company wished to submit a definite schedule and it was in accord with the general policy and requirements of the commission in other respects, an order would be issued.

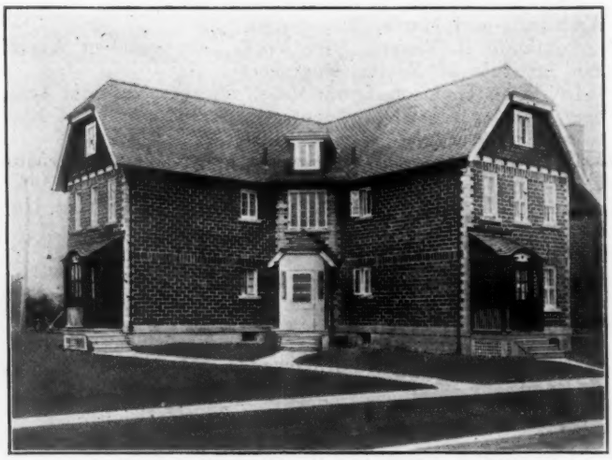
WORKMEN'S HOUSES OF THE SHAWINIGAN POWER COMPANY

Attractive Homes Built for Employees at Shawinigan Falls—Groups of Two, Three and Five Dwellings

Attractive houses for workmen have been built by the Shawinigan Water & Power Company at Shawinigan Falls, Quebec.

Groups of three types are shown in the photographs reproduced herewith. In one there are three distinct dwellings, the two end houses being of similar design and somewhat different from the center one. In another there are two dwellings of similar design. The third group of houses shown contains five individual dwellings.





TYPES OF HOUSES PROVIDED FOR ITS EMPLOYEES BY SHAWINIGAN WATER & POWER COMPANY AT SHAWINIGAN FALLS, QUEBEC

HIGHER COAL COST AND RATES IN PITTSBURGH

President Callery of Duquesne Light Company Says that Coal Cost Was 100 per Cent Higher —Revised Schedule

In the annual report of the Duquesne Light Company, Pittsburgh, for the year ended March 31, 1917, President James D. Callery refers as follows to higher coal cost and revision of rate schedule:

During the year the company has had to contend with extraordinarily high prices for coal. This item alone increased $748,605, which represents practically 100 per cent increase over last year, while the sale of energy increased about 30 per cent and the kilowatt output for the year increased 32 per cent over last year. The added cost of coal is partly due to the failure of the coal contractors to live up to their contracts owing to the miners' strike of two months in the early part of the season and the shortage of cars thereafter, which necessitated the company buying part of its requirements of fuel in the open market.

In the last three months of the year the production cost per kilowatt-hour on the system as a whole has increased 1.56 mills, caused chiefly by the extremely high price of coal.

During the latter part of the year a new schedule was filed with the Public Service Commission which provides for an increase in the price of energy to power consumers on the basis of an advance or a decline in the price of coal, and the company is now operating under the revised schedule.

THE NEW ENGLAND POWER SECURITY ISSUE APPROVED

Massachusetts Commission Recognizes the Need for Enlarging and Improving the Company's System and Assuring Sufficient Funds

A majority of the Massachusetts Gas and Electric Light Commission has approved the application of the New England Power Company for authority to issue additional securities of the par value of $7,000,000 in stock and bonds to meet the cost of enlarging and improving the system as recently outlined in the ELECTRICAL WORLD. On this projected work $96,000 had been expended prior to June 30, 1917, chiefly upon line extensions and new substation construction. In view of the small amount expended Commissioner Lewenberg voted against granting the petition. He maintained that the company's credit should be sufficient to enable it to raise the necessary funds, at least in large part, and stated that as the construction company owned by the petitioner is likely to do the work the chances of low competitive bids by outside contractors appear uncertain.

The company contended in the proceedings before the board that the approval of the latter is an important factor in financing the improvements contemplated at the present time. The majority, in approving the petition, points out that whereas the cost of the work rests so far mainly upon estimates made with regard for the existing abnormal prices of labor and materials, the work will cover a considerable period and it may be that actual costs will differ from the estimates. "The company claims with considerable force," says the majority opinion, "that the expenditure upon the further development of the water power of the Deerfield River is so large that it cannot finance this project without the assurance in advance that the means for its completion are available. The undertaking is so important to the welfare of the State that the board has no hesitation in giving this assurance so far as its action is necessary to this end, and is of the opinion that upon the terms expressed in the order the public interests will be safeguarded." These terms included postponing for one year the sale of 10,000 shares of common stock. The commission approves the issue of 20,000 preferred and 20,000 common shares at $100 par value and $3,000,000 in bonds. The improvements to be made include the construction of a 22,000-kw. hydroelectric plant at Readsboro, Vt., with a large storage reservoir, substation development, and raising the pressure on certain lines from 66,000 volts to 110,000 volts.

SHIPPING BOARD SEEKS TO BUY 3000 ELECTRIC FANS

That Number of Direct-Current Desk and Wall Fans Needed Next Year for the Cargo-Handling Ships Now Being Built

Quotations are requested by the United States Shipping Board on all or any portion of 3000 commercial-type, non-oscillating 12-in. (30-cm.) electric fans, complete and suitable in every respect for marine service on board the cargo-handling ships now being constructed for the Emergency Fleet Corporation, with the option of increasing the quantity awarded by 50 per cent within thirty days of award.

The fan is to operate on a direct-current circuit at 116 volts, is to have three speeds with control at base, and may be either of the four-blade or the six-blade, wire-guarded type. The fan must run silently without undue humming, buzzing or rattling. The fan is to be mounted on a neat-appearing, wide-flaring base, with felt bottom, and is to be provided with swivel and hinge (or equivalent) joint, to permit directing the breeze at any angle, either horizontally or vertically. The motor is to be entirely inclosed and is to have properly designed bearings with wick oil cups which require no attention. Armature and field coils are to be moisture-proof and oil-proof and are to have insulation resistance and dielectric strength in accordance with the Standardization Rules of the American Institute of Electrical Engineers. Brushes and windings are to be easily accessible. The fan must be so arranged that it can be used as either a desk or a wall fan by a simple adjustment, and it must be provided with suitable holes in the base for fastening to a desk or wall by means of screws. The necessary number of base-fastening screws must be furnished with each fan.

The fan is to be furnished complete with all accessories, but without connecting cord and disconnecting plug or socket. The finish is to be standard black enamel (baked) with polished brass blades and guards, but alternatives will be considered for finish in all-white enamel or in all-one-color enamel of tint to be prescribed later by the corporation.

In submitting proposals bidders are requested to state the horsepower (or wattage rating) of the fan, the energy consumption at the various speeds at 116 volts, the three speeds of operation, the weight (both net and shipping), the number of fan blades, the quantity of air displaced per minute against free air (de-

rived from actual tests, the nature of which are to be described, together with the manner of conducting tests and by whom conducted), and the distance at which the breeze may be appreciably felt in a large inclosed room. Bidders are also asked to submit drawings, cuts, specifications and other data showing fully the detailed design of the fan and the construction of the armature, field, bearings and joint. A list of recommended spare parts, together with the net prices thereof, is also requested. Deliveries must begin Jan. 1, 1918, and be completed Oct. 1, 1918. Shipments will be made in lots of ten fans in one package. No bidding bond is required.

INCREASING EXPENSES AFFECT OPERATING RESULTS LARGELY

In First Six Months of 1917 Net Earnings of American Light & Traction Company Decrease $476,000

A report of the American Light & Traction Company shows that extra costs affected operating results materially. The report says in part:

For the last six months of 1916 net earnings showed an increase of $183,056, while for the first six months of 1917 net earnings showed a decrease of $476,505, making a decrease for the year ended June 30, 1917, of $293,449.

This decrease was due to conditions beyond the control of the management of your company or its subsidiaries, and was caused in part by extraordinary increases in expenses, due to increased cost of material, labor and taxes, during the six months ended June 30, 1917, as follows:

Coal, oil and coke		$350,846
Labor		146,408
Taxes, subsidiary companies, local	$77,928	
Taxes, subsidiary companies, federal	162,600	
Taxes, American Light & Traction, federal	124,000	364,528
Total		$861,782

The subsidiary companies show substantial increases in gross business for the six months ended June 30, 1917, as follows:

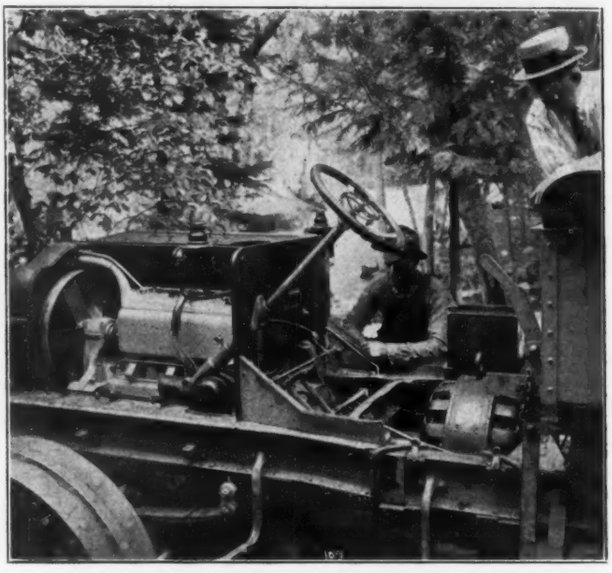
		Per Cent
Gas sales, cu. ft.	1,014,316,000	12.78
Gas income	$805,312	13.84
Electric sales, kw.-hr.	4,017,443	15.08
Electric income	$107,470	9.66
Street railway, passengers	2,200,882	21.65
Street railway income	$104,932	21.50

EMERGENCY GENERATING OUTFIT IN THE YOSEMITE

It Being Impossible to Complete the Hydroelectric Station in Time, an Automobile Outfit Was Pressed into Service with Good Effect

Guy L. Bayley, formerly chief electrical and mechanical engineer for the Panama-Pacific International Exposition, sends us the following account of an emergency lighting outfit pressed into service in the Yosemite National Park. Mr. Bayley is building a 2500-kw. electric plant at Yosemite for the Department of the Interior to care for the growing needs of the valley. Inasmuch, however, as the station could not be finished in time to handle this season's load, something had to be done to augment the output of the existing equipment. The latter comprised two 75-kw., 2300-volt, two-phase generators, belt-driven by Pelton wheels. The size of the penstock is such that only 120 kw. can be obtained. About 30 kw. of additional power was needed to care for the peak this season, and the accompanying illustration shows how this amount of power was secured.

A White good roads truck having a six-cylinder engine rated at 60 hp. was pressed into service. The transmission gear box was removed, and in place of it a 30-hp., 1200-r.p.m., 220-volt induction motor which had been used on the construction work at the new dam was installed. The motor was connected directly to the engine through a flexible coupling and operated as



EMERGENCY LIGHTING PLANT AT YOSEMITE

an induction generator. Owing to the frequency of the plant being above normal, it was necessary to operate the engine at 1350 r.p.m. at full load. The auxiliary plant has operated every night over the peak for two months without giving any trouble. On test, it delivered 25 kw. for four hours, and this output has been exceeded for short periods. There is no governor on the engine, and the outfit is started up through regular motor compensator. As soon as the engine starts to fire, the throttle is opened to the point corresponding to full load, the waterwheel units taking care of the load variations.

The truck was installed just outside of the old power house and is cared for by the station operator, a boy being employed to watch the supply of water to the radiator and to replenish the gasoline and oil. The successful installation and operation of the plant was due to the co-operation of the local plant of the White Company and J. W. Emmert, chief electrician for the government.

COAL CLAUSE IN RATES OF A MISSOURI COMPANY

Missouri Gas & Electric Company, Operating at Richmond, Introduces Change in Schedules Based on Fuel Expense

T. M. Bradbury, secretary Missouri Public Service Commission, replying to an inquiry of the ELECTRICAL WORLD, writes that the commission has not as yet granted authority to increase electric rates on account of higher coal costs. One application was pending when Mr. Bradbury wrote, and he said that it would no doubt be granted unless a specific protest was received within a few days.

The increase asked for applies to the electric com-

pany at Richmond, Mo., owned by the Missouri Gas & Electric Service Company, Chicago. The proposed increase is set out in the following "rider":

Coal Clause.—It is agreed and understood that the aforesaid secondary charges hereof shall be subject each month to an addition of 0.06 cent per kilowatt-hour for each 10 cents of increase in the cost of coal during such month to the Missouri Gas & Electric Service Company above $2.60 per ton delivered at the company's generating plant. The secondary charges shall likewise be subject each month to a deduction of 0.06 cent per kilowatt-hour for each 10 cents decrease in the monthly cost of coal to the company below $2.10 delivered as aforesaid. The cost of coal herein mentioned is based upon coal of a standard quality of approximately 11,500 B.t.u.

This is to apply only to the wholesale rate for alternating current, which rate is as follows:

Primary Charge.—$2.25 per month per kilowatt for the first 50 kw. of maximum demand in the month; $2 per month per kilowatt for the excess of the maximum demand over 50 kw.

Secondary Charge.—4 cents per kilowatt-hour for the first 1000 kw.-hr. used per month; 2.5 cents for the next 4000 kw.-hr., and 1.25 cents for all in excess of 5000 kw.-hr.

PRESENT WAR TO BE FOUGHT OUT ON ENGINEERING LINES

Old Military Lines Have Practically Been Thrown Aside for Special Industrial Organization Whose Business Is War

"This is a war of engineers." Just what does this oft-quoted phrase mean? Capt. Gustave P. Capart of the general staff of General Pétain, who is at present in this country as a member of the French scientific commission, indicates that the answer to this question involves a new understanding of what military operations are to-day.

When it is stated that this is a war of engineers, that statement means that the old military lines of organization have practically been thrown aside at the front, and in their place has been built up a specialized industrial organization whose business is war. We no longer have infantry, cavalry and artillery in the old sense of the words. We have a planned organization for offensive military operations, in which the plans are made on an engineering basis, in which the fighting is done in many branches of the service by engineering methods, and of which the operations are carried on by engineering work in roadmaking, in transportation, in industrial management and factory operations.

Captain Capart, in an interview with the ELECTRICAL WORLD, points out that this war is being fought with prime materials. Old warfare was a football game compared with the modern struggle, in which tons of material are hurled back and forth between opposing armies and carloads of foods, of machinery and supplies and of men are constantly transported to the line of action on both sides.

The modern battle, Captain Capart states, is a problem of roads and a problem of transport. In the maintenance of railways and roads, as well as in the construction of new extensions, a large and highly trained personnel is required for the laying of tracks, for repair shops, drivers and conductors, for the handling of construction material, etc.

Cableways and telpherage systems have given extraordinarily valuable service at the front. In one installation 600 mules were turned to other service by the installation of a telpherage system. The automobile, with its camions and its tractors, is another link in the service.

The electrical engineer is playing a wonderful part in this war. Great distribution systems for electric light and power have been necessary for the use of armies. The headquarters of the armies, the cantonments, artillery, repair shops, hospitals, air service, etc., all use electric power. Machinery and skilled men are necessary for air compressing, rock drilling, trenching machines, etc.

The government of the United States has comprehended fully the importance of organization of engineers in these many lines, and the engineer regiments which have already responded to the military needs indicate the ability of this country to furnish the class of men needed for the military industrial work.

In this country we must understand that to prosecute the war successfully we must think not only of materials and of human energy in tremendous totals, but we must think of using materials and literally of using human energy with the highest efficiency. Men must be selected for their places in this great industrial war, not on the basis of their physical characteristics alone, not on their ability to carry a gun, but on the basis of special knowledge to fit them for positions of responsibility and of specialized training which this war of engineers demands.

UNITED STATES CAN PROFIT BY ALLIES' EXPERIENCE

Captain Capart believes that in the United States we have the opportunity to combine the knowledge and the experience of what has been done in three years of war, and that our armies should go to France organized in such a way as to fit them for the industrial task which lies ahead of them. Captain Capart points out that our engineers who go to France as military men in their specialized branches will also be pioneers of American industry in times of peace and will prepare the ground for the economic war which is expected to follow when the military battles are over.

Military operations may be thought of as being conducted to-day in four zones—first, the firing line; second, the military zones immediately surrounding the firing line; third, the avenues and channels of communication between the military zone and what may be called the world-wide zones of supplies to that military zone, and, fourth, the zones of supplies themselves, which include the countries at war and the countries which are supplying food, machinery and materials for the countries at war.

Captain Capart points out that specialized engineering training is necessary in all these war zones. On the firing line—troops in contact with the enemy—engineers are involved in the strictly military operations, mining engineers are planning the executing of trench work, earth work, concrete work and so on. On this same battle line are engineers who maintain what the French so interestingly explain as a "liaison"—the nerves of communication between the various sectors of the armies, the telephone, the telegraph, the semiphore, the wig-wag system, wireless, heliograph; in short, the co-ordination of communication by every means known to science.

In the military zone, which is entirely in the control

of the military and potentially and actually threatened by the enemy, engineers are busy building and maintaining roads, constructing, maintaining and operating railroads, building, rebuilding and operating automobiles, constructing narrow-gage railroads, cableways, telpherage systems, etc. In this military zone electrical engineers are at work building and operating lighting and power plants, erecting and maintaining distributing lines, handling the network of telephone and wireless centers of communication. Waterworks and water-supply engineers, sanitary engineers, engineering construction gangs erecting shelters and raising camps and cantonments and repair shops for aeroplanes, automobiles, artillery, small arms—all are necessary, and more are required in the military zone.

In the same way, Captain Capart has indicated that engineers with their specialized knowledge are needed especially in the great problems that touch upon the transportation of the necessary materials between the military zone and the sources of supply which constitute what we have called the fourth great zone.

In this country we have already started the organization of this work, and the organization of the engineers and scientific men for the military army which is necessary to stay at home and maintain and develop the men, machinery and supplies needed at the front.

In all this organized army of specialized men every man is as essential as every other to carry forward the military plan. As Captain Capart puts it, "the soldier in the obscure post who works as a lineman is equally to be admired and honored with the soldier who sights the gun across the trenches."

U. S. ARMY IS TO ENLIST CORPS OF TELEPHONE MEN

Members, Who Must Be Practical Linemen, Will Do Construction, Maintenance and Cable Work for the Coast Guard

The recruiting officers of the United States Coast Guard have been authorized to undertake immediately the enlistment of a special force of linemen for duty in connection with the Coast Guard telephone system.

Applicants for enlistment as linemen must pass the required physical examination of the Coast Guard, and if found qualified must enlist for a period of one year. Men who receive honorable discharges or ordinary discharges with recommendation for re-enlistment may re-enlist for succeeding periods of one year each. All linemen will be required to be practical telephone men, and when enlisted will be known as electricians. They must be experienced in all branches of telephone work, including construction, maintenance and cable work, and possess sufficient ability to prepare estimates for utensils and labor.

All applicants when first enlisted will be rated as acting electricians at a salary of $72 a month, with an allowance of 45 cents a day for rations, and in addition they will receive an allowance for clothing of $45 at the expiration of their first year's enlistment, provided they receive an honorable discharge, and an allowance of $20 a year for every year thereafter, subject to the same condition. They will have the benefit of Coast Guard provisions for medical treatment and retirement.

TREASURY DEPARTMENT NEEDS MORE ELECTRICAL ENGINEERS

Supervising Architect's Office Plans to Train Applicants to Design Entire Mechanical Equipment of Buildings

There are at present a few vacancies in the engineering force of the mechanical and electrical engineering division of the office of Supervising Architect of the Treasury Department. In order to obtain an eligible list from which permanent appointments to these positions may be made, a non-assembled examination will be held by the Civil Service Commission on Sept. 4. Any one desiring to take the examination should request a copy of Form 2118 from the Civil Service Commission immediately. Particular attention is called to the statement in the circular that an applicant will not be required to report for examination at any place.

Pending the establishment of an eligible list temporary appointments will be made. Such appointees, if they take the non-assembled examination above referred to and pass with a sufficiently high average, are eligible for permanent positions. Any engineers who would like such an appointment are requested to send in their names and ages, a brief history of their engineering training, lowest salary they will be willing to start at, and the earliest time they could report for duty after receipt of notification of appointment.

A majority of the engineers appointed are versed in heating and ventilating work, or in electrical work, only, but it is the aim of the Supervising Architects' office so to train them that they shall be able to design the entire mechanical equipment of a large building.

HOSTILITIES SUSPENDED ON THE CLEVELAND FRONT

Illuminating Company Will Provide Energy While Head of Competing Company Is "Somewhere in the Service"

The Cleveland *News* published the following in a recent issue:

While Colonel Dudley J. Hard, Second Ohio Artillery, is fighting in France, his little light company back in Cleveland will be safe. It was 1894 that the late C. V. Hard and his son, now Colonel Hard, started the Cleveland Light & Power Company. While the company never grew into a large concern, it persistently held its "place in the sun" against the larger illuminating company. At present Hard's company has 200 customers, mostly downtown.

Since Colonel Hard must go to war, and can't be here to nurse along the midget company, he was compelled to throw himself upon the mercy of the Illuminating company. Colonel Hard asked the Illuminating company to sell him juice at wholesale rates, to be redistributed to his customers while he is in France. This was Hard's only way of saving his company.

"I'd like to have something to come back to after the war—if I come back at all," said Colonel Hard.

By denying Hard wholesale energy, the Illuminating company would have put the little concern out of business. Two hundred desirable customers would have been gained by the "big monopoly." But the Illuminating company is sportsmanlike, also patriotic.

"While Colonel Hard is in France, his company will get all the energy it wants," said Mathias Turner, assistant general manager of the Illuminating company. "Colonel Hard may lead his men to battle feeling sure that while he is away the Illuminating company will not try to steal any of his customers."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Abandonment of Line Authorized.—The California Railroad Commission has authorized the Oakland, Antioch & Eastern Railway Company to discontinue operation of the line of the Sacramento Valley Electric Railroad extending from Dixon Junction to Dixon, 11.8 miles. The company has been operating this as a branch line since Jan. 1, 1915, under a verbal agreement which the operating company is permitted to terminate at its option. During the year ended Dec. 31, 1915, the branch line was operated at a net loss of $9,423; for the year ended Dec. 31, 1916, at a net loss of $9,358, while the loss for the five months ended May 31, 1917, is reported at $3,839. The commission says: "It is evident that the operation of the line is conducted at a considerable financial loss, the deficit shown above including no taxes or depreciation. An analysis of the operating expense accounts does not indicate that any excessive charges have been made against the operation of the line; in fact, a less expense per car mile has accrued on the Dixon branch than on the main line of the Oakland, Antioch & Eastern Railway. An investigation by the service department of the commission indicates that the traffic handled and the possibility of increased traffic does not warrant the recommendation that the line be continued in operation."

Accounting in New York.—The Appellate Division of the New York State Supreme Court has upheld a ruling of the Public Service Commission, First District, that the system of accounting prescribed by the commission must be followed by companies under its jurisdiction. The decision was rendered in a certiorari proceeding brought by the Kings County Lighting Company to review a ruling of the commission. Authority had been given to the company to issue $134,545 bonds, the condition being that the proceeds should be used only to make good the indisputable depreciation of the property of the company. The court held that the law authorized the commission to prescribe uniform accounting systems. In reference to accounting for depreciation the court said: "In no event could the commission, without taking an independent proceeding against the relator, in which the relator would have notice and an opportunity to defend itself, make an order requiring it to change its whole system of accounting and put its depreciation charge upon some other basis than that adopted by the company under the law and the earlier order of the commission." Discussing the use for extensions of part of a depreciation reserve fund, the court said that such a proceeding "would be tantamount to permitting the relator to borrow money for the purpose of providing for a depreciation fund, a practice unsound in principle, and one which would ultimately lead a company into a serious financial condition. The commission therefore was naturally willing only to permit the treasury to be reimbursed by an issue of bonds on condition that such part of the proceeds as were equivalent to the sum spent out of depreciation reserve should be restored, and it coupled its permission with such a condition." The court also decided that the company was entitled to fix such a rule or rate for depreciation as it saw fit, and that this rule was to govern until the commission fixed a different rule or rate, as the commission had the power to do at any time when it might see fit.

Abnormal Conditions Make High Money Rates.—The California Railroad Commission has authorized the Southern California Edison Company to issue $10,000,000 bonds, the proceeds to be spent as far as available for the following purposes: $3,000,000 to add to the Big Creek hydroelectric plant and transmission line to Los Angeles; $983,287 to pay obligations for purchase of Mount Whitney Power & Electric Corporation stock; $4,000,000 to pay obligations for purchase of $5,000,000 Pacific Light & Power Corporation first and refunding bonds; $5,554,891 to pay Edison company and Pacific Corporation outstanding notes. The Edison company is authorized to execute a deed of trust of its properties as security for an issue of $136,000,000 general and refunding mortgage bonds, of which the $10,000,000 specified may be sold immediately. The bonds are to be issued in series, each series to mature at a date and bear interest at a rate to be determined by the company's directors. The 1917 series, though, matures July 1, 1919, with interest at 6 per cent. The company states that a syndicate will underwrite the $10,000,000 issue so as to net the company 95.62 and to return the syndicate and its managers 3 per cent. "This results," says the commission, "considering the two-year term of these bonds, the discount at which they are sold and the interest rate, in a cost of this money to the Edison company of 8.4 per cent." The Edison company insists that this is an abnormally high price to pay for money, and that it does not set the standard for the credit of the company. The company's representatives say that the financial market at present makes it difficult to sell high-class securities of any kind and impossible to sell such securities unless they are attractive as to price and safety. The commission, in rendering its decision, calls attention to the high price of oil. If the market cost of oil is considered, says the commission, the company will save by increasing its power plant as specified $700,000 a year, and under its contract price for oil, $350,000.

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month on the next-to-last text page.

Empire State Gas and Electric Association.—A meeting of the Electric Production Committee of the Empire State Gas and Electric Association was held on July 13 at Buffalo, N. Y. The meeting opened with a general discussion of the action taken by the different companies regarding the loss of employees called to war or subject to call. There was also a discussion of wages paid different classes of station labor and the hours worked by different shifts. I. E. Powell gave an outline of the bonus system employed in one of the steam power plants in Rochester.

National Association of Purchasing Agents.—The annual congress of purchasing agents, under the auspices of the national association, will be held at Pittsburgh, Oct. 9, 10 and 11. The program includes business sessions for the mornings and visitation and inspection of industrial works during the afternoons. Special features will be a tour of Pittsburgh's principal business districts by automobile and a cabaret dinner at one of the country clubs. The banquet will be held at the convention hotel on the evening of Oct. 10, with speakers of national prominence in attendance. James H. Robison is chairman of the publicity committee.

The Pacific Electrical Supply Jobbers' Association.—The regular quarterly meeting of the Pacific Electrical Supply Jobbers' Association was held at Del Monte, Cal., July 27-30, with representatives of all Pacific Coast centers from Seattle to Los Angeles in attendance. At the open meeting Saturday morning a paper on "Loyalty" was read by Garnet Young, Benjamin Electric Company, San Francisco, which provoked much discussion. In the comment on this subject, representatives of central stations, jobbers and manufacturers participated and exchanged views. There was general approval of a creed touching on this subject read by T. E. Bibbins, Pacific States Electric Company, San Francisco, which was as follows: "(1) That at all times I must be loyal to myself, my company and its policies; (2) that I should consistently support the manufacturer whose lines I have agreed to sell; (3) that every manufacturer who plays the game, whether I buy from him much or little, should have from me all reasonable encouragement and always a fair deal; (4) that I recognize the right of my competitor to live and prosper and no policy should be employed by me which is destructive to his rights; (5) that my first and last thought should be for the betterment of the electrical industry and for service to all my customers."

Muskogee Company to Offer Stock to Consumers.—The Muskogee (Okla.) Gas & Electric Company, a Byllesby property, will offer preferred stock to customers.

Change in Control of Mount Carmel (Pa.) Company.—Chandler & Company, Philadelphia, have bought control of the Edison Electric Illuminating Company, Mount Carmel, Pa.

Bureau to Better Working Conditions.—At a recent meeting of the Chicago chapter of the American Association of Engineers it was decided to form an information bureau in the hope of bettering the working conditions of engineers in the chapter's jurisdiction. This bureau, controlled and selected by the executive committee of the Chicago chapter, will assume the duties of the service clearing house of the national organization in its district. In addition to listing open positions in the community, this bureau will conduct a secret investigation of the working conditions of the various concerns. Thus, when a prospective employee wishes to start to work, he will have an insight into conditions in the office in which he is to work, including a knowledge of the hours of employment, the man who will have authority over him and the chances for advancement.

Federal Aid for Vocational Teaching.—The Carnegie Foundation for the Advancement of Teaching has issued as its tenth bulletin a study of federal aid for vocational education by Dr. I. L. Kandel of the Foundation staff. The bulletin traces in Part I the legislative history of federal aid for education and presents a detailed analysis of the debates in Congress on the numerous bills introduced at various times between 1857 and 1890 by Senator Justin S. Morrill for the establishment of land-grant colleges, as well as the bills for agricultural experiment station appropriations and increased grants for land-grant colleges and experiment stations. Such an analysis brings out prominently the fact that the educational aspect of the problem received but the scantiest attention. The chief interest of Congressmen was in the constitutional questions involved. Part II of the bulletin is devoted to a study of many of the questions to which the preceding analysis gave rise—the constitutional and educational precedents of the movement for federal aid for education. Part III gives an account of the subsequent developments of the Morrill act and discusses the influence of this precedent on the recent movement for the extension of the principle of federal grants to the whole field of vocational education. The conclusion is reached that the recently passed Smith-Hughes act is reproducing the history of the Morrill act in involving the federal government in great expenditures of money before a sound educational policy and system of supervision and control have been formulated. Copies of the bulletin may be had by addressing the Carnegie Foundation, 576 Fifth Avenue, New York City.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Electrical Voting Machine for Argentine Deputies.—The Argentine Embassy at Washington announces that bids are invited by the Argentine government for the designing, manufacture and installation of an electrical voting machine for the Chamber of Deputies of Argentina. American manufacturers who desire to submit bids may obtain particulars from Lieut. Eng. O. D. Michetti, 620 Woodward Building, Washington, D. C.

Electrical Trade Opportunities in Guatemala.—United States Consul Samuel C. Reat, writing from Guatemala City regarding Guatemala trade, says: "In manufactures of iron, copper, tin and lead and their compounds the United States supplied during 1916 over 93 per cent of the import trade, the increase in electrical goods more than equaling Germany's loss; but after the war American manufacturers may have to meet vigorous competition in these lines, especially as Germans control the largest electrical installation in Guatemala and their concession is practically a monopoly. The further development of electric lighting and power in small units on the larger coffee, cane and other plantations offers an opportunity that can be safely sought."

Bonus for Houston Employees.—At the annual outing of employees of the Houston (Tex.) Lighting & Power Company recently, Edwin B. Parker, the president, announced that all employees other than officers would be paid a monthly bonus of 5 per cent of their salaries. Mr. Parker said in part: "We have much important work ahead of us. Aside from its steady, substantial growth, the exigencies of war are bringing to Houston mobilization camps, shipyards and other activities which require service at the hands of this company, and which in turn require large expenditures by this company at a time when new capital is hard to procure. But this company must do its full part—and will find a way to do its full part—in the upbuilding of this city, and to that end I bespeak the hearty co-operation of each and all of you. From your own experience you know that the cost of living has greatly increased during the past year, and in order to assist you in bridging the gap caused by such increase the company has recently arranged to pay each of you other than officers a 5 per cent monthly bonus. But you must not lose sight of the fact that the high cost of living applies to the company as well as to individuals, and with the increased cost of copper and all other materials, of fuel oil, of taxes, city, state and federal, the cost of operating this company has greatly increased and is still increasing, calling in turn for the most rigid economy. Each and all of us are expected cheerfully and wholeheartedly to put forth our best efforts to give to this company and to the people of Houston and its environs prompt, courteous, efficient service at a minimum of cost. May I not confidently rely on each and all of you to join with me in fulfilling this expectation?"

Change in Control of Berkshire Company.—C. D. Parker & Company, Inc., of Boston have bought control of the Stockbridge (Mass.) Lighting Company. The same interests bought control previously of the Lenox Electric Company and the Great Barrington Electric Light Company. It is reported that the companies will be operated together or consolidated.

Power Load Grows Rapidly in St. Louis, Mo.—On account of the fact that high coal prices are making owners of isolated plants scrutinize generation costs more closely, the power sales business of the Union Electric Light & Power Company, St. Louis, is growing by leaps and bounds. Within a short period the power sales department has signed contracts with the following companies for large blocks of power: The *Post-Dispatch*, 1000 kw.; Hotel Statler, 350 kw.; Lindell Department Store, 150 kw.; Mercantile Trust Company, 100 kw.; Hamilton-Brown Shoe Company, 500 kw.; Brown Shoe Company, 250 kw.; Leschen Rope Company, 200 kw., and Missouri Fire Brick Company, 150 kw. In each case the data on kilowatts indicate the demand of the installation, and not the connected load.

Profit-Sharing for Cities Service Employees.—The profit-sharing system for employees that will be in operation in the Cities Service Company after Aug. 1 has for its cornerstone the installment payment plan. Any member of the Doherty organization may subscribe for stock, and the amount of his subscription depends upon the length of employment and the amount of his yearly salary. Those who have been employed less than five years are permitted to invest only an amount representing a certain proportion of their salary. For example, a man employed less than a year may subscribe for stock equal in amount to 50 per cent of his yearly income. A person employed three years and less than four may invest 80 per cent, and so on. Furthermore, certain limitations are placed upon the amount. A further restriction is that whatever money the employee invests in the stock will be used to purchase twice as much preferred stock as common. When an employee desires to enter the profit-sharing scheme he agrees to pay for his stock in installments. Every one in the plan pays sixty equal monthly installments, so that at the end of five years he will have paid up all the stock.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

W. F. Bellinger has been made chief load dispatcher of the system of the Georgia Railway & Power Company, Atlanta, Ga.

J. F. Stokes, local manager for the Hydro-Electric Power Commission of Ontario, Canada, at Tweed, has resigned to enlist for overseas service.

A. T. Hicks, local manager for the Hydro-Electric Power Commission of Ontario, Canada, at Trenton, has been transferred to Oshawa to succeed C. U. Peeling, who resigned.

Frank W. Casler, formerly general superintendent of plant of the Public Service Electric Company of New Jersey, is now general superintendent of production for the same company.

C. U. Peeling, local manager for the Hydro-Electric Power Commission of Ontario, Canada, at Oshawa, has resigned to accept the position of manager of the electric, gas and railway properties at Cornwall, Ont.

R. M. Boykin, engineer of the North Coast Power Company of Portland, Ore., has been elected vice-president and appointed general manager of the company, following the resignation of H. L. Harries, who is at the military training camp at Presidio.

W. B. Miser, formerly general superintendent for the Illinois Traction System at Jacksonville, Ill., has been appointed manager of the Drumright (Okla.) Light & Power Company, one of the new properties recently acquired by H. M. Byllesby & Company and which will be part of the enlarged Oklahoma Gas & Electric Company.

H. R. Gore has resigned his position as auditor of the Eastern Pennsylvania Railways Company, Pottsville, Pa., to accept a position with Haskins & Sells, public accountants, New York. Prior to being assigned to that company he served as auditor of the Kentucky Public Service Company, Bowling Green, Ky., both of these utilities being under the management of the J. G. White Management Corporation, New York.

J. B. Shickel has been appointed superintendent and electrical engineer for the Menominee & Marinette Light & Traction Company, Menominee, Mich., to succeed J. C. Strong. Mr. Shickel was graduated from the Rose Polytechnic Institute of Terre Haute, Ind., in 1907. Since that time he has been with the General Electric Company at Schenectady, N. Y., first in the testing department and later in the special engineering and sales departments.

George A. Sawin has been appointed to the new position of service engineer of the Public Service Electric Company of New Jersey, reporting directly to the vice-president and general manager. Mr. Sawin will decide for the operating department on all applications for power and follow through matters between the engineering, production, distribution and commercial departments occasioned by such applications. The position of illuminating engineer in the operating department will be discontinued.

L. Barr is now connected with the Buick Motor Company of Flint, Mich.

Montague Ferry, who was formerly Commissioner of Public Service for the city of Chicago, and who more recently was in the employ of the B. F. Goodrich Company, Akron, Ohio, designing radio systems for dirigible balloons, has accepted a position as production manager for the Curtiss Aeroplane Company at Buffalo, N. Y.

Lawrence N. Siler, a mechanical and electrical engineer of the J. G. White Management Corporation, New York, N. Y., has been assigned to the engineering staff of the Manila Electric Railroad & Light Company, Manila, P. I., which is being operated by the management corporation. Mr. Siler is a graduate of Cornell University.

J. F. CUMMINGS

V. G. Corkins has been appointed superintendent of the North Coast Power Company at Chehalis, Wash. He was formerly connected with the Nevada Valley Power Company, Lovelock, Nev., being employed prior to that by the Northwestern Electric Company, Portland, Ore. He is acting as manager of the company in the absence of W. A. Schoel, who is at the Presidio in the training camp.

W. C. Austin has been transferred from the staff of traveling auditors of the J. G. White Management Corporation, New York, to the position of auditor of the Eastern Pennsylvania Railways Company. This utility furnishes railway and electric service in Pottsville, Pa., and vicinity, and is operated by the management corporation. For a number of years Mr. Austin was treasurer and auditor of the Otsego & Herkimer Railroad Company (now the Southern New York Power & Railway Corporation), Cooperstown, N. Y.

Obituary

James Fulton Cummings, widely known as a pioneer distribution engineer both in the United States and Europe, died from a stroke of apoplexy at Long Beach, Long Island, N. Y., on July 26. Mr. Cummings was born at London, Ont., on May 6, 1869, his father being Alfred A. Cummings, author of "The Maple Leaf Forever," Canada's anthem. His earlier education was obtained in the schools of his native city, to which was added a university course at Toronto. In the days when those in the electrical industry developed young he connected himself for a brief period with the Michigan Telephone Company, and in 1889 accepted a position in the engineering department of the parent Edison interests. Although an exceedingly versatile and resourceful engineer, he at once specialized on making model installations of Mr. Edison's then marvelous underground system, contributing to the improvement of its feeder system and junction boxes. Some of the important installations of this character with which he was connected were in Philadelphia, Cincinnati, St. Paul and Milwaukee, the latter at the time at which it was made (1891 to 1893) being generally considered as the best of all such installations. Shortly after the parent Edison corporations had been merged in the present General Electric Company Mr. Cummings severed his connection therewith and produced the once well-known Cummings underground conduit system, of which several important installations were made in this country, the most notable perhaps being at Detroit and Pittsburgh. While this work was in progress he also invented one of the very earliest systems of interior conduit, if not the first, and with a partner established a factory at Pittsburgh for the production of material required therefor. During the 90's, as appears from the records of the United States Patent Office, many important patents of the character just indicated were granted to him. In 1897, having sold his American patents and business interests, he removed to London, where he opened a large contracting office in the interest of prominent American manufacturers of conduit material. Specific business accomplishments of Mr. Cummings abroad were many important underground installations in the United Kingdom and still others in Italy, the most notable of the latter being at Milan and Turin. Perhaps his greatest business accomplishment, however, was in Russia, where he installed a similar system in Petrograd, covering the entire city, which attracted wide attention in the technical press and electrical circles of both Europe and America. As an incident of his early work in the expansion of the electrical industry, he played an important rôle in the organization of the first electrical show in this country, which was held during the 90's at Madison Square Garden, New York City. This pioneer exhibition paved the way for annual events of the same kind in many cities.

REVIEW OF TRADE AND MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

THE EXTENT OF FRENCH FOREIGN ELECTRICAL TRADE

Recently Published Figures Show Imports to the Value of $12,221,300 in 1916, and Exports to the Value of $9,272,800

Official figures showing the foreign trade of France during the years 1916, 1915 and 1914 in electrical materials, as published in the Revue Générale de l'Electricité, are contained in the accompanying table. The imports, which it will be noticed are much greater than the exports for 1916, amounted to $12,221,300, in comparison with $4,849,000 in 1915 and $4,779,800 in 1914. The exports for 1916 were $9,272,800, as compared with $5,262,000 in 1915 and $6,301,000 in 1914.

France, it will be remembered, since the beginning of the war has realized the vast economic possibilities of her water powers and is fast developing them. Plans for the period following the war include a tremendous development in hydroelectric plants. For that reason it is safe to assume that the French market for electrical goods will undoubtedly increase considerably.

IMPORTS

	1916	1915	1914
Dynamos	$3,020,000	$1,256,800	$1,051,800
Electrical appliances	3,066,600	1,239,600	2,637,600
Dynamo frames and parts	3,500	11,200	600
Incandescent lamps:			
Carbon-filament	29,400	1,400	6,200
Metal-filament	608,200	58,400	214,000
Unassembled	600	...	3,600
Arc lamps and parts	1,600	800	7,400
Lighting carbons	865,800	654,400	56,400
Insulated wire and cable	2,813,200	741,400	67,400
Induction machinery and parts	1,490,000	597,200	416,800
Magnets and their electromagnets	3,600	800	25,800
Storage batteries and parts	65,000	97,800	19,800
Dry batteries	124,800	92,600	26,600
Porcelain, glass and similar insulators	128,500	96,600	245,800
	$12,221,300	$4,849,000	$4,779,800

EXPORTS

Dynamos and transformers	$203,000	$201,800	$577,200
Electrical appliances	2,431,600	1,364,800	1,814,400
Generator and motor parts	200	200	...
Incandescent lamps	291,800	357,600	34,200
Arc lamps and parts	10,800	23,000	30,200
Carbon for electrical and other industrial purposes	5,151,800	2,417,600	1,265,000
Insulated wire and cable	242,000	199,600	853,800
Induction machinery	694,200	462,200	402,400
Magnets other than electro	2,200	2,600	1,200
Storage batteries and parts	134,400	145,200	132,000
Dry batteries	...	...	...
Porcelain, glass and similar insulators	110,800	87,400	190,600
	$9,272,800	$5,262,000	$6,301,000

QUICK DELIVERY WORK ON GOVERNMENT TRANSFORMERS

Arrangements for Rapid Shipment of Raw Materials to Successful Bidders, Who Guarantee to Make Shipment in Certain Time

Many transformers, including a wide range of capacities and voltages, have been purchased recently by the government, presumably for use in connection with the army encampments and other installations. When the government first started placing the orders considerable difficulty was experienced in getting reasonable deliveries, owing to the inability of the manufacturers to obtain the raw materials promptly. It is understood that the practice is now for the government, when it submits specifications, to ask the manufacturers to quote a price and to specify how soon they can ship after they receive the raw material. Then, when the order is placed with the successful bidder, the government immediately requests from the bidder specifications for the raw material that will enter into the construction of the equipment. The government then arranges with the raw-material producer to make a shipment of raw material promptly. For example, if transformer sheet steel is required, it is understood that the government arranges with some manufacturer of this product to assign a mill to its manufacture until the requisite amount of steel has been rolled. By following this procedure the government is now able to obtain a splendid delivery on equipment that would under the old system require a prohibitively long time for its production. The ELECTRICAL WORLD is advised that a large number of transformers are being purchased on this basis.

THE WEEK IN TRADE

MARKET conditions remained quiet during the past week. The excessive heat which prevailed over the major portion of the country put a damper on trading. Office and factory hours were shortened, decreasing sales and also production to a slight extent. Stocks throughout the entire country are being replenished for the heavy buying expected in the fall. The government continues to demand supplies for cantonments and shipbuilding, and deliveries for this work are on the whole good.

The demand for fans was great and in many sections exceeded the supply.

The metal market was quiet and prices remained about the same. Prices of electrical supplies changed very little.

NEW YORK

The excessive heat of the last few days has made not only the members of the trade but business itself very languid, and to the uncertainty of the price-fixing program in Washington are now added the almost unprecedented weather conditions. Many factories have had to close down or run on short time, and two hours a day has been cut off from usual office hours. While business has been very dull in metals, no weakness has developed, sellers being quite as indifferent about doing business as buyers.

The demands on local stocks have, on the whole, been below normal, undoubtedly because of weather conditions. The largest demand that has ever been made for fans in New York City arose during the past week, and practically all stocks were depleted.

The buying by jobbers is falling off and stocks are fast filling up to the limit. Local building still continues to fall off, with no change in sight during the month. Collections continue to increase.

TURBINES.—A loan of $5,000,000 has been issued by the Consolidated Power Company, a new organization, for the benefit of the Consolidated Gas, Electric Light & Power Company of Baltimore, Md. The proceeds of these notes are to be used in adding very largely to the production of electricity for the Consolidated Gas, Electric Light & Power Company. This company has ordered two 22,000-kva. turbo-generators and two condensers, to be furnished by the Westinghouse Electric & Manufacturing Company of

East Pittsburgh, Pa. To furnish additional power to industrial plants in the vicinity of Westport, Md., the same company has purchased four 12,000-kva. and one 1750-kva. Westinghouse transformer, all rated 13,200 volts to 2640 volts, three-phase, 25 cycles.

HOUSEHOLD DEVICES.—Washing machines are in steady demand, probably because of the servant problem in the New York territory. Vacuum cleaner sales fell off a bit during the past week. The demand for dishwashers is reported to be picking up considerably.

HEATING APPLIANCES.—The demand for heating appliances is normal, no marked changes occurring during the past week. Ranges are moving along nicely, it is reported.

LAMPS.—Local stocks are in good shape. On Aug. 1 the Mazda C-2 lamp, a further step in Mazda lamp development, was announced. It is said that this lamp embodies all the characteristics of the regular Mazda C construction, with the additional advantage that its light is an exact match in color quality with average daylight. The bulb of this lamp is blue. It is made in six sizes, ranging from 75 watts to 500 watts. This lamp should prove in great demand in office buildings, museums, surgeries, stores of every size and character, factories, etc.

WIRE AND CABLE.—The demand for wire and cable during the past week was quiet. Deliveries are slow, but local stocks appear to be in fair condition. Weatherproof wire, however, is in great demand by the government.

FANS.—Owing to the unusually hot spell during the past week, the fan manufacturers were pressed to the limit and in many cases were unable to supply the demand. Local stocks were practically cleaned out by Thursday. Many jobbers ran out the first day of the hot spell and were unable to replenish their stock. Jobbers who wisely got in a good stock early in the season were able to hold out exceedingly well through the hot spell. This past week should serve as a lesson to the jobber who puts in a small stock early in the season and expects to get immediate delivery upon placing his order in the middle of the season. Prices jumped considerably during the week owing to the heavy demand—reported to be heavier than ever—experienced in the New York territory. Heavy shipments are reported to be on the way, and dealers expect to stock up to be ready for future warm days.

COLLECTIONS AND CREDITS.—Collections for July were excellent and the prospects for August loom up well. Credits are still tightening up with certain classes of trade.

STANDARD PORCELAIN.—Deliveries continue better, and owing to the slack in the demand for the past week stocks should pick up.

FIXTURES.—Because of the inactivity of the building of apartment houses, hotels, etc., fixtures have been in little demand and there appears to be no change.

MOTORS.—It is reported that one of the large manufacturers is spending considerable money in making numerous extensions to present plants in order to take care of present unfilled orders and expected near future demand. These improvements will help deliveries.

TRANSFORMERS.—Distributing transformers are hard to get. Some of the large companies, it is reported, have sold their distributing transformer outputs for twelve months ahead.

CHICAGO

There has been very little change in the general business situation in the Chicago territory in the past week. Indications are that top-notch prices have not yet been reached on some lines of goods, but the price level is more steady now than it was some weeks ago. Advance buying is not so much a factor in the market as it has been, and there is not the same strife for merchandise as was seen before the United States joined the belligerents.

The following observation of the National City Bank of Chicago in its Aug. 1 bulletin is particularly applicable to the electrical industry in the Chicago territory at the present moment: "Manufacturers and merchants are shaping their affairs with reference to providing for the vicissitudes of a 'war market' and the possibility of a peace declaration before many months have elapsed. There are many uncertainties to deal with in such a situation, but the thing to remember is that the crop outlook has improved and most of the great industries have more working capital than they ever had before, and that the country as a whole is protected by the largest gold reserve that any nation ever had at this or any other season. It is evident, therefore, that, war or no war, the United States is about the last nation for any sane man to 'go short of' at this stage of the game."

FANS.—Some jobbers are entirely cleaned out of fans; others have broken lines, but are out of certain types. It is a notable fact that the fan season this year in the Chicago territory was about as late as it ever has been.

FARM-LIGHTING PLANTS.—The fact that the crop outlook is so favorable leads manufacturers and distributers of farm-lighting plants to expect a fine fall business.

POLE-LINE MATERIAL.—Cross-arms, lag screws and other units of pole-line construction increased about 10 per cent in price.

INSULATORS.—No large orders for porcelain insulators are being placed. Production at the factories is the main problem at present.

STORAGE BATTERY TRACTORS.—The volume of business in storage battery tractors continues brisk, some government orders having been secured both for machines to be used in this country and abroad.

WIRE.—The wire factories are experiencing an unusual situation. The demand for large conductors is very good, while the demand for such wire as is used in ordinary residence work and in fixture wiring is slackening off. This is attributed to the fact that industrial plant work is going ahead but that other builders are being deterred by the high prices of construction material. Deliveries on the smaller sizes of wire are becoming very prompt.

GENERAL BUILDING.—Statistics covering the first half of 1917 show that some ninety large cities reported in that period reduced expenditures for building operations as compared with the year before. This movement is not considered unusual in view of the high cost of steel and the difficulty of securing quick deliveries at any price.

CLAY CONDUITS.—The Clay Products Company of Indianapolis has increased its plant capacity 66 per cent. The company is finding it necessary constantly to quote higher prices to all except its larger contract customers.

CANTONMENT EQUIPMENT.—The Ross Power Equipment Company, Indianapolis, reports success in selling motors, pumps and transformers, both new and second-hand, to the government for additional facilities at Fort Benjamin Harrison.

LIGHTING STANDARDS.—A contract for 450 ornamental "white way" lighting standards with copper Cleveland lanterns has just been closed by the Union Metal Manufacturing Company for installation in Cleveland, Ohio.

BOSTON

Little evidence of midsummer dullness appears in the electrical trade this week in New England. The volume of business holds up well, although a recession in new business is reported from Rhode Island jobbing circles. Large jobbers at Boston are busy and one of the principal houses reports excellent credit conditions. The favorable decision of the Massachusetts Gas and Electric Light Commission last week in the New England Power Company's seven-million-dollar security case spells more business along highly desirable lines of manufacture and distribution. Deliveries are about the same, perhaps a trifle better than a week ago, and few price changes have come to hand. Pole-line hardware is up about 15 per cent compared with two weeks ago. Fan movement was heavy and in some quarters made up for a slight decrease in general trade. Rapid progress is being made in the wiring of the cantonment at Ayer, which is expected to be ready for the drafted troops Sept. 1. As yet no great alarm is apparent with regard to labor shortage, but current well-informed opinion holds that many readjustments will have to be made. Here and there labor is

showing unrest, but in general conditions are reasonably good. A linemen's strike has been settled on the Berkshire Street Railway within the week.

SMALL MOTORS.—A tendency toward contraction in sales may be noted upon looking back several weeks. It is difficult to determine whether the cause is temporary saturation of the market or prevailing long deliveries. There is no question that the latter are a retarding influence with regard to a part of the volume of trade, and it is difficult to believe that the limit has been reached in regard to the absorption of labor-saving equipment. Any general stock accumulation appears problematical at present. It is still by no means assured that the price maximum has been reached.

FANS.—The abnormal heat wave of last week has virtually drained jobbers' stocks; in some cases fans have been sold off the desks of the jobbers' clerical staff to meet the demand. The seasonable weather relieved an eleventh-hour surplus in some quarters.

SEWING-MACHINE MOTORS.—A brisk campaign is reported as successful, one central station selling seventy-five in a single week.

WASHING MACHINES.—These are moving well and plans are under way for a vigorous fall campaign.

ELECTRIC RANGES.—These are moving well, and a strengthening of suburban demand was noted in the past week.

APPLIANCES.—Missionary work by advertisers and demonstrators, assisted by special campaigns, is producing a gratifying number of "trail-hitters," despite a curtailment of installment privileges on the part of some central stations. Vacuum cleaners are becoming more popular, and the outlook is good for industrial heating appliances this fall.

ELECTRIC SIGNS.—Business is rather quiet, and at present there is little evidence of a heavy fall trade. Coal shortages doubtless affect the exploitation of signs adversely at this time. Labor conditions are good in the sign field.

POLE-LINE HARDWARE.—Prices tend to advance steadily, current quotations being about 15 per cent above those of a fortnight back. Heavy demands are noted for industrial service.

WIRE AND CABLE.—Prices remain even on rubber-covered and weatherproof wire, despite a heavy demand.

CONDUIT.—Stocks are becoming low; deliveries are very poor and the situation is trying.

CONDENSING AND COOLING APPARATUS—Demand is steady and substantial, with increasing foreign inquiries. Reported easing of pig iron is expected to hold back further price advances, at least for the immediate future.

ELECTRIC RANGES.—An order for fifteen hotel-type ranges was recently received and delivered by the Simplex Electric Heating Company, Cambridge, Mass., for the Naval Training Station, Newport, R. I.

ATLANTA

The Southeastern lighting and power utilities have been under considerable pressure for the last six months due to the heavy demand for service from industrial sources. A number of companies have reached the point where large investments will have to be made in order to take care of future requirements. There is a hesitancy in certain sections in regard to starting construction work at this time when material and labor are scarce and prices high. On the other hand, some of the larger companies are taking a more optimistic view of the situation and are planning big developments. A case in point is the Georgia Railway & Power Company, Atlanta, which has petitioned the state commission for authority to issue short-term notes covering the installation of the sixth 12,000-kw. unit at its Tallulah Falls plant, a new storage basin above the Mathis dam, and a complete 50,000-kw. development on the Tugaloo river 2 miles below the present Tallulah Falls development.

The new building situation looks good, and a number of large structures are being planned on which permits will be issued shortly.

Financial circles report a slight tendency toward retrenchment along certain lines and a stiffening of interest rates. Collections remain excellent, showing an improvement over the last week in July. The jobbers are doing a good business and contractors report a healthy condition.

ARMORED FLEXIBLE-STEEL CONDUCTOR.—The inability of the trade to secure prompt shipments on rigid conduit has quickened the demand for the armored product. Prices are steady and stocks are in fair condition.

CONDUIT PRODUCTS.—Shipment promises have been advanced to six to eight weeks. Manufacturers prefer smaller orders which are well distributed rather than the larger ones.

VENTILATING EQUIPMENT.—Up to this week the movement of this line has been slow and considerably below normal, but the quick change in temperatures from cool to hot has tended to break this condition. Long deliveries on motors have also affected this year's sales.

FANS.—The strong movement of 8-in. and 12-in. fans during the past week is the reflection of the return of seasonable weather. Stocks are still quite complete.

GENERAL SUPPLIES.—Deliveries in all lines of supplies will probably be slow for some time owing to manufacturers giving preference to government orders.

APPARATUS.—The industrial motor demand is lessening, probably owing to the vacational period and uncertainty as to the fuel market. Deliveries, however, show no improvement. There is a strong buying movement in transformers of all capacities, and stocks are badly depleted in the smaller sizes. Shipment promises on the larger capacities are lengthening.

ST. LOUIS

Probably the thing that impresses most forcibly an individual who is making an analysis of conditions in the St. Louis territory is the almost universal complaint of "slow deliveries." The manufacturers assert that they cannot obtain raw materials, the jobbers state that they cannot get the manufactured product from the factories, and the ultimate consumer complains that he cannot in many cases obtain what he desires from his jobber. However, as the representative of one important concern explained, the statement that deliveries are in general poor should be taken in a relative sense. "While it is true that many things are hard to get, it is also true that purchasers are in many instances getting greater quantities of these things than ever before in their histories." For example, one motor manufacturer is now shipping a greater number of motors than ever before, but the concern could sell a great many additional machines if it could obtain the raw material wherewith to manufacture them. On the whole, deliveries do not appear to be improving. The congestion in shops and on the railroads is such that it is not easy to predict whether or not the delivery situation will be more satisfactory in the immediate future.

In so far as general conditions are concerned, there is little change from last week. If there has been any change in volume of sales, it is probably an increase because a few interests have reported that their sales were notably better last week than during the preceding. None has reported a decrease. Collections appear to be better. Some of the manufacturers are tightening up on the credits to the jobbers because of the greatly increased investments which are now required for merchandising. Labor, both skilled and unskilled, is very scarce in the larger cities in this territory. One organization is advertising that it will pay $9 a day for carpenters.

WIRING SUPPLIES.—New building operations seem to be decreasing materially. An accurate index to this situation is the fact that the applications for the electrical inspection of wiring installations are in volume one-half of those being handled this time last year. Consequently the demand for wiring supplies, except possibly those of the types which are used in industrial plants, is considerably below normal.

WROUGHT-IRON CONDUIT.—Considerable conduit was received in St. Louis last week, so that, temporarily at least, the situation regarding this product is more satisfactory. The jobbers are still obtaining card prices for immediate delivery.

WIRE.—There has been no change in prices, but a number of concerns received last week consignments which had been on order for a long time, so that the general situation in regard to deliveries is somewhat better. The stocks are, however, not up to normal.

FANS.—In spite of the fact that there was a hot wave through a portion of this territory last week, fan-motor sales have not in general been what might be expected. It is reported that several local jobbers have canceled orders for fan motors which were to have been delivered last spring but which the manufacturers have only now completed. It appears not unlikely, therefore, that some of the smaller manufacturers will carry over fan-motor stocks for next year, although other manufacturers report that they have been sold out.

POLE-LINE HARDWARE.—One jobber reports that the deliveries to his concern are improving appreciably and that the business in this particular line is better than in many years. It is doubtful, however, whether the above statement would hold for the territory as a whole.

AUTOMOBILE STARTING AND LIGHTING EQUIPMENTS.—Manufacturers report a decided improvement in the demand for these devices. The motor-car manufacturers are issuing releases to ship equipments which have been on order for some time and certain concerns have put on additional men to produce these outfits.

SEATTLE

Business in the Northwest is still in an unsettled condition, owing specifically to the fact that mills and logging camps are tied up with strikes. Nearly every mill and camp in the Grays Harbor and Puget Sound district is idle, with no likelihood of immediate resumption. Lumber production is reported 53 per cent normal. Four shipyards in the Grays Harbor district and two in Olympia have been closed by strikers. Apparently the threatened shipyard strike in Seattle has been averted. The workers have been assured by union officials that negotiations for a new agreement embodying an upward revision of the wage scale are progressing favorably. As the electrical jobbers derive the major portion of their business from the above industries, the outlook is depressing. With the settlement of the street car strike in Tacoma and Seattle a slight increase in sales, particularly of miscellaneous appliances, was noted in those cities. Practically no new construction work is reported. The freight situation is fairly satisfactory when conditions are considered. The usual fall ordering has been light. Jobbers do not expect to load up, conditions being too uncertain. Credits and collections are satisfactory. The transformer demand is keeping up because of new power development. Quotations on copper are unchanged from last week. Seattle jobbers report very light sales. While material contracts for the American Lake cantonment were secured by Eastern firms, Seattle jobbers, owing to large stocks on hand, thus far have been able to take care of pick-up requirements.

CONDUIT.—Stock is low and deliveries are poor, but demand is fairly heavy. Prices remain unchanged.

CABLE.—Power cables show fair demand, but delivery is slow.

LAMPS.—There is a fairly large stock of lamps on hand despite normal demand. No change in prices in past week.

HEATING APPLIANCES.—The recent advance in heating appliances caused a curtailment in sales; however, the demand is fair, but delivery very slow.

WIRING DEVICES.—Adequate stocks on hand; falling off in demand owing to small amount of building.

POLE-LINE MATERIAL.—Practically no demand except in isolated cases. Power companies are making few extensions to stocks.

FANS.—Portland and eastern Washington cities report heavy sales of fans due to recent warm weather.

SAN FRANCISCO

Very little construction such as hotels, apartments and office buildings is under way. There are few specifications in the hands of the architects and there is no prospect of immediate change in this line. In addition to the uncertainty of wartimes, this is partly due to the difficulty of getting labor, both skilled and unskilled. Such labor as there is available has been uncertain. Strikes and I. W. W. troubles have been frequent, so that both owners and contractors are disinclined to take risks. The shortage of maids and household help generally has greatly helped the electrical trade. Domestics are attracted to factories by high wages, and with decreased immigration the household problem has become more and more acute. Within six weeks one of the largest jobbing houses has increased its sale of washing machines four times. Practically all household labor-saving devices are likewise unusually active. Even electric range sales are keeping up remarkably well under the advanced price. Temporary relief from quiet building conditions continues to come in the shape of industrial and government orders, particularly with firms that are equipped to handle the latter. The government business has more than offset the falling off in the other line. Collections have been slowing up slightly, this being noticeable chiefly in the larger accounts. Contractors and dealers are still meeting obligations remarkably well. The first few days in August indicate a better financial situation than last month. Conduit stocks are being reduced, and some apprehension is felt for the future in this line because of expected slow deliveries. Wire is scarce because of large cantonment orders and slow deliveries, but the decrease in building activity has cut down the normal demand. Stocks of practically all other roughing-in materials are good because of the decrease of the usual outlet in building work.

METAL MARKETS CONDITIONS

Copper Stagnant and Unchanged—Few Changes in Prices for Past Week

The flurry in the market in the last ten days was apparently due to speculative sentiment based upon decreasing production and the possibility of a falling off in imports as well as in domestic output. These factors were made use of to bring about a further advance in nearby deliveries early last week, but there was a lack of support in actual transactions and at the close of the week the tendency of prices was again downward. Electrolytic copper is nominally held at 28 cents for spot and August shipment, 27.50 cents for September, and 26.50 cents to 27 cents for shipment over the last quarter of the year.

The lead market is in a firm but quiet condition. Old metals remain about the same.

NEW YORK METAL MARKET PRICES

	July 30	Aug. 6
Copper:	£ s d	£ s d
London, standard spot	125 0 0	125 0 0
Prime Lake	29.50 to 30.00*	29.50 to 30.00*
Electrolytic	28.00 to 28.50*	28.00 to 28.50*
Casting	26.50 to 27.00*	28.00 to 28.50*
Wire base	33.00 to 33.50*	33.00 to 33.50*
Lead, trust price	11 00	10.92½
Nickel, ingot	50.00	50.00
Sheet zinc, f.o.b. smelter	19.00	19.00
Spelter, spot	8.55 to 8.67½	8.67½ to 8.80
Tin, Straits	63.60	63.75
Aluminum, 98 to 99 per cent	46.00 to 48.00*	46.00 to 48.00*

OLD METALS

Heavy copper and wire	24.00 to 24.50	24.00 to 25.00
Brass, heavy	15.00 to 15.50	15.50 to 16.25
Brass, light	12.50 to 13.00	13.50 to 14.00
Lead, heavy	8.75 to 9.00	8.75 to 9.00
Zinc, old scrap	6.25 to 6.50	6.25 to 6.50

*Nominal.

Current Prices of Electrical Supplies

NEW YORK AND CHICAGO QUOTATIONS

The prices quoted are those prevailing in standard package or specified lots on apparatus and appliances in Eastern and Middle West markets at the beginning of business on Monday of this week. They are in all cases the net prices or prices subject to discounts from standard lists to contractors, central stations, dealers and others engaged in the resale of such goods.

Prices in Southern and other nearby markets will rule about the same as those in the Middle West, although slight modifications to cover increased freight and local demands should be expected. In the Far West and on the Pacific Coast the prevailing prices are naturally higher, covering as they must increased freight and the necessity of larger stocks with increased interest and warehouse charges on account of the distances from sources of supply, infrequent turnover of stock and uncertainty as to delivery of goods in transit. Moreover, the Far West presents a wide variation in demand due to a small population spread over a wide area in agricultural and mining communities, as contrasted with the denser population of the East and Middle West, their nearness to the source of supply, the more frequent turnover in stocks and the constant demands which arise in industrial centers.

The variation in prices may be due to the difference in grade of products made by different manufacturers, to local conditions or to both.

ARMORED CONDUCTORS, FLEXIBLE STEEL

Single-Conductor

B. & S. Size	List, per 1000 Ft.
No. 14 solid	$61.00
No. 12 solid	71.00
No. 10 solid	90.00
No. 8 solid	106.00
No. 6 solid	145.00
No. 10 stranded	95.00
No. 8 stranded	115.00
No. 6 stranded	160.00
No. 4 stranded	205.00
No. 2 stranded	266.00
No. 1 stranded	315.00

Twin-Conductor

No. 14 solid	104.00
No. 12 solid	135.00
No. 10 solid	185.00
No. 8 stranded	235.00
No. 6 stranded	370.00
No. 4 stranded	575.00

NET PRICE PER 1000 FT.—NEW YORK

Single-Conductor

No. 14 solid:	
Less than coil	$54.90 to $61.00
Coil to 1000 ft	48.80 to 59.17
No. 12 solid:	
Less than coil	63.90 to 71.00
Coil to 1000 ft	56.80 to 68.87

Twin-Conductor

No. 14 solid:	
Less than coil	$78.00 to $104.00
Coil to 1000 ft	75.00 to 80.00
No. 12 solid:	
Less than coil	121.50 to 135.00
Coil to 1000 ft	108.00 to 130.95

DISCOUNT—CHICAGO

Single-Conductor

Less than coil	+10%
Coil to 1000 ft	10%

Twin-Conductor

Less than coil	+10%
Coil to 1000 ft	10%

ATTACHMENT PLUGS

List ranges from $0.22 to $0.30 each. Standard packages from 100 to 250.

DISCOUNT—NEW YORK

Less than 1/5 std. pkg	—10% to 12%
1/5 to std. pkg	10% to 20%
Std. pkg.	34% to 44%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg	—20% to 12%
1/5 to std. pkg	Net to 20%
Std. pkg.	30% to 44%

BATTERIES, DRY

NEW YORK

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 50	.35	.35
50 to barrel	.31	.32
Barrel lots	.28	.29

BATTERIES, DRY—Continued

CHICAGO

Each Net	No. 6 Regular	No. 6 Ignitor
Less than 12	$0.40	$0.40
12 to 30	.35	.35
50 to barrel	.31 to .31¾	.32 to .32¾
Barrel lots	.28	.28¾

CONDUIT, METALLIC FLEXIBLE

Size. In.	Ft. per Coil	List per 100 Ft.
5/16	250	$5.00
⅜	250	7.50
½	100	10.00
¾	50	13.00
1	50	21.00
1¼	50	26.00
1½	25–50	35.00
2	25–50	45.00
2½	25–50	52.00

NET PER 1000 FT.—NEW YORK

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$67.50 to $75.00	$60.00 to $69.75
⅜-in. double strip	71.75 to 75.00	63.75 to 72.00
½-in. single strip	90.00 to 100.00	80.00 to 93.00
½-in. double strip	95.00 to 100.00	85.00 to 96.00

NET PER 1000 FT.—CHICAGO

	Less than Coil	Coil to 1000 Ft.
⅜-in. single strip	$71.25 to $75.00	$60.00 to $63.75
⅜-in. double strip	75.00 to 78.75	67.50 to 71.25
½-in. single strip	95.00 to 100.00	80.00 to 85.00
½-in. double strip	100.00 to 105.00	85.00 to 95.00

CONDUIT, NON-METALLIC FLEXIBLE

Size, In.	List, per Foot	Size, In.	List, per Foot
7/32	$0.05½	1	$0.25
¼	.06	1¼	.33
⅜	.09	1½	.40
½	.12	1¾	.47
⅝	.15	2	.55
¾	.18	2¼	.65

NET PER 1000 FT.—NEW YORK

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.	$55.00	$24.50-$25.50	$21.50-$24.75
¼-in.	$40.00-$60.00	$27.00-$30.00	$23.50-$27.00

NET PER 1000 FT.—CHICAGO

	Less Than $15 List	$15 to $60 List	$60 to $150 List
7/32-in.	$55.00	$25.50-$27.50	$23.10-$24.75
¼-in.	$60.00	$30.00	$25.20-$27.00

CONDUIT, COUPLINGS AND ELBOWS, RIGID IRON

Card No. 38

Size, In.	Conduit, List per Foot
¼	$0.08½
⅜	.08½
½	.08½
¾	.11½
1	.17
1¼	.23
1½	.27½
2	.37
2½	.58½
3	.76½

	Couplings, List	Elbows, List
¼	$0.05	$0.19
⅜	.06	.19
½	.07	.19
¾	.10	.25
1	.13	.37
1¼	.17	.45
1½	.21	.60
2	.28	1.10
2½	.40	1.80
3	.60	4.80

DISCOUNT—NEW YORK

	¼ In. to ½ In.	¾ In. to 3 In.
Less than 2500 lb.	6% to 8%	8% to 10%
2500 to 5000 lb.	9% to 11%	11% to 13%

(For galvanized deduct six points from above discounts.)

DISCOUNT—CHICAGO

	¼ In. to ½ In.	¾ In. to 3 In.
Less than 2500 lb.	3.8% to 8%	5.8% to 10%
2500-5000 lb.	6.8% to 10%	8.8% to 13%

(For galvanized deduct six points from above discounts.)

FLATIRONS

NEW YORK

Net	$3.50

CHICAGO

Net	$3.15 to $4.20

FUSES, INCLOSED

250-Volt	Std. Pkg.	List
3-amp. to 30-amp.	100	$0.25
35-amp. to 60-amp.	100	.35
65-amp. to 100-amp.	50	.90
110-amp. to 200-amp.	25	2.00
225-amp. to 400-amp.	25	3.60
450-amp. to 600-amp.	10	5.50
600-Volt		
3-amp. to 30-amp.	100	$0.40
35-amp. to 60-amp.	100	.60
65-amp. to 100-amp.	50	1.50
110-amp. to 200-amp.	25	2.50
225-amp. to 400-amp.	25	5.50
450-amp. to 600-amp.	10	8.00

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	28%
1/5 to std. pkg.	38%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	28%
1/5 to std. pkg.	38% to 39%

FUSE PLUGS

3-Amp. to 30-Amp.

NEW YORK

	Per 100 Net
Less than 1/5 std. pkg.	$5.75 to $6.30
1/5 to std. pkg.	4.50 to 5.25

Standard package, 500. List, each, $0.07.

CHICAGO

	Per 100 Net
Less than 1/5 std. pkg.	$6.25
1/5 to std. pkg.	5.25

Standard package, 500. List, each, $0.07.

LAMPS, MAZDA

105 to 125 Volts

Regular, clear:	Std. Pkg.	List, Each
10 to 40-watt—B	100	$0.27
60-watt—B	100	.36
100-watt—B	24	.65
75-watt—C	50	.65
100-watt—C	24	1.00
200-watt—C	24	2.00
300-watt—C	24	3.00
Round bulbs, 3⅛ in., frosted:		
15-watt—G 25	50	.50
25-watt—G 25	50	.50
40-watt—G 25	50	.50
Round bulbs, 3¾ in., frosted:		
60-watt—G 30	24	.72
Round bulbs, 4⅝ in., frosted:		
100-watt—G 35	24	1.05

DISCOUNT—NEW YORK

Less than std. pkg.	Net
Std. pkg.	10%

DISCOUNT—CHICAGO

Less than std. pg.	Net
Std. pkg.	10%

LAMP CORD

Cotton-Covered, Type C, No. 18

NEW YORK

	Per 1000 Ft. Net
Less than coil (250 ft.)	$30.00 to $34.88
Coil to 1000 ft.	21.00 to 26.52

CHICAGO

	Per 1000 Ft. Net
Less than coil (250 ft.)	$37.20 to $38.16
Coil to 1000 ft.	27.90 to 28.62

LAMP GUARDS, WIRE

Standard packages from 50 to 150.

NEW YORK

Net per 100	$18.00 to $29.00

CHICAGO

Net per 100	$13.33 to $25.50

OUTLET BOXES

Nos.	List, per 100
101—A, A1½, 4 S.C., 6200, 320	$30.00
102—B.A., 6200 S.E., 300, A.X. 1½, 4 S.	30.00
103—C.A., 9, 4 R, B 1½	25.00
106—F.A., 7, C.S. 1½, 3 R.	20.00

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $10.00 list	List to 33%	List to 27%
$10.00 to $50.00 list	List to 42%	37%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $10.00 list	40%	35%
$10.00 to $50.00 list	50%	45%

PIPE FITTINGS

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	10%
1/5 to std. pkg.	20%
Std. pkg.	30%

PORCELAIN CLEATS—UNGLAZED

2 and 3 Wire

NEW YORK

	Per 1000 Net
Less than 1/5 std. pkg.	$14.00 to $20.00
1/5 to std. pkg.	13.00 to 15.00

Standard package, 2200. List per 1000, $20.

CHICAGO

	Per 1000 Net
Less than 1/5 std. pkg.	$16.80 to $20.54
1/5 to std. pkg.	13.00 to 19.24

Standard package, 2200. List per 1000, $20.

PORCELAIN KNOBS

NEW YORK

	5½ N.C.—Solid Nail-it—N.C.	
Per 1000 Net	Std. Pkg. 3500	Std. Pkg 4000
Less than 1/5 std. pkg.	$10.50 to $24.30	$28.00
1/5 to std. pkg.	9.75 to 12.15	21.50

CHICAGO

	5½ NC.—Solid Nail-it—N.C.	
Per 1000 Net	Std. Pkg. 3500	Std. Pkg. 4000
Less than 1/5 std. pkg.	$11.85 to $18.00	$20.75 to $33.60
1/5 to std. pkg.	9.00 to 11.70	16.30 to 25.80

SOCKETS AND RECEPTACLES

	Std. Pk.	List
⅛-in. cap key and push sockets	500	$0.33
⅛-in. cap keyless socket	500	.30
⅛-in. cap pull socket	250	.60

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std pkg.	15% to 20%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%

SWITCHES, KNIFE

250-Volt, Front Connections, No Fuse

High Grade:	List
30-amp. S. P. S. T.	$0.80
60-amp. S. P. S. T.	1.20
100-amp. S. P. S. T.	2.25
200-amp. S. P. S. T.	3.48
300-amp. S. P. S. T.	5.34
30-amp. D. P. S. T.	1.20
60-amp. D. P. S. T.	1.78
100-amp. D. P. S. T.	3.38
200-amp. D. P. S. T.	5.20
300-amp. D. P. S. T.	8.00
30-amp. 3 P. S. T.	1.80
60-amp. 3 P. S. T.	2.68
100-amp. 3 P. S. T.	5.08
200-amp. 3 P. S. T.	7.80
300-amp. 3 P. S. T.	12.00
Low Grade:	
30-amp. S. P. S. T.	0.42
60-amp. S. P. S. T.	0.74
100-amp. S. P. S. T.	1.50
200-amp. S. P. S. T.	2.70
30-amp. D. P. S. T.	0.68
60-amp. D. P. S. T.	1.22
100-amp. D. P. S. T.	2.50
200-amp. D. P. S. T.	4.50
30-amp. 3 P. S. T.	1.02
60-amp. 3 P. S. T.	1.84
100-amp. 3 P. S. T.	3.76
200-amp. 3 P. S. T.	6.76

DISCOUNT—NEW YORK

High Grade:	
Less than $10 list	List to —5%
$10 to $25 list	11% to 16%
$25 to $50 list	14% to 24%
Low Grade:	
Less than $10.00 list	5% to —5%
$10.00 to $25.00 list	11% to 16%
$25.00 to $50.00 list	14% to 24%

DISCOUNT—CHICAGO

High Grade:	
Less than $10 list	+5%
$10 to $25 list	11%
$25 to $50 list	14%
Low Grade:	
Less than $10.00 list	5%
$10.00 to $25.00 list	16%
$25.00 to $50.00	24%

SWITCHES, SNAP AND FLUSH

5-Amp. and 10-Amp., 125-Volt Snap Switches

	Std. Pkg.	List
5-amp. single-pole	250	$0.28
5-amp. single-pole ind.	250	.32
10-amp. single-pole	100	.48
10-amp. single-pole, ind.	100	.54
5-amp., three-point	100	.56
10-amp., three-point	50	.76
10-amp., 250-volt, D. P.	100	.66

SWITCHES, SNAP AND FLUSH—Cont'd

10-Amp. 250-Volt Push-Button Switches

	Std. Pkg.	List
10-amp. single-pole	100	$0.45
10-amp. three-way	50	.70
10-amp. double-pole	50	.70

DISCOUNT—NEW YORK

Less than 1/5 std. pkg.	Net
1/5 to std. pkg.	15%
Std. pkg.	28%

DISCOUNT—CHICAGO

Less than 1/5 std. pkg.	—20% to Net
1/5 to std. pkg.	15% to Net
Std. pkg.	30%

SWITCH BOXES, SECTIONAL CONDUIT

Union and Similar	List, Each
No. 155	$0.34
No. 160	.60

DISCOUNT—NEW YORK

	Black	Galvanized
Less than $2.00 list	List to 23%	18%
$2.00 to $10.00 list	20% to 23%	18%
$10.00 to $50.00 list	23% to 30%	18%

DISCOUNT—CHICAGO

	Black	Galvanized
Less than $2.00 list	25% to 50%	15% to 40%
$2.00 to $10.00 list	25% to 50%	15% to 40%
$10.00 to $50.00 list	35% to 64%	25% to 52%

TOASTERS, UPRIGHT

NEW YORK

Net price	$3.10 to $3.50

CHICAGO

Net price	$2.80 to $3.50

WIRE, ANNUNCIATOR

NET PRICE—NEW YORK

No. 18, less than full spools	$0.52
No. 18, full spools	0.48

CHICAGO

	Per Lb. Net
No. 18, less than full spools	$0.65 to $0.6885
No. 18, full spools	0.5285 to 0.56

WIRE, RUBBER-COVERED, N. C.

Solid-Conductor, Single-Braid

NEW YORK

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$15.00-18.00	$12.00-14.50	$11.50-12.50
12	21.06-28.35	18.96-24.30	18.01-20.25
10	29.60-39.83	26.64-34.14	25.31-28.45
8	42.40-56.49	38.16-48.42	36.25-40.35
6	72.19-89.39	64.98-76.62	61.73-63.85

CHICAGO

	Price per 1000 Ft. Net		
No.	Less than 500 Ft.	500 to 1000 Ft.	1000 to 5000 Ft.
14	$18.00	$16.00	$14.00
12	25.99-29.89	21.96-25.62	20.13-23.48
10	36.49-42.28	30.84-36.24	28.27-33.22
8	51.54-60.13	43.80-51.50	40.15-47.25
6	74.80-82.20	68.00-75.35	56.54-61.20

WIRE, WEATHER-PROOF

Solid-Conductor, Triple-Braid, Sizes 4/0 to 8 Inc.

NEW YORK

	Per 100 Lb. Net
Less than 25 lb.	$40.25 to $45.00
25 to 50 lb.	39.25 to 42.00
50 to 100 lb.	38.00 to 38.25

CHICAGO

	Per 100 Lb. Net
Less than 25 lb.	$38.35 to $45.35
25 to 50 lb.	37.35 to 44.35
50 to 100 lb.	36.35 to 43.35

NEW APPARATUS AND APPLIANCES

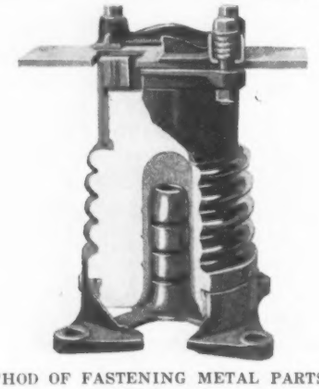
A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Calculator for Determining Metered Loads Directly

A calculating device has recently been perfected by C. M. Hoag and C. F. Backstrand of Riverside, Cal., that is constructed on the principle of the circular slide rule with scales arranged for determining metered loads directly, without the use of a meter formula. The calculator may be used by a person not familiar with meter formulas. The following results may be read directly with a setting on the calculator: Horsepower and kilowatt load, power cost in dollars per hour and necessary ampere rating for meters at any voltage or load. It is adapted for use with Westinghouse, General Electric or Fort Wayne meters, and the device may also be used as a slide rule for other calculations.

Post-Type Insulators

The Electrical Development & Machine Company of Philadelphia has developed a method of fastening metal parts to its post-type insulators. By means of the method adopted it is possible to produce an insulator having extremely high cantilever and tensile strength, it is claimed. The insulator base and top are made with wide, shallow grooves for holding the threaded collar, which is a metal composition molded around the insulator. This operation is done by a special device, which drives the metal under high pressure around the porcelain. The operation is practically instantaneous and when complete forms intimate contact with the surface of the porcelain.

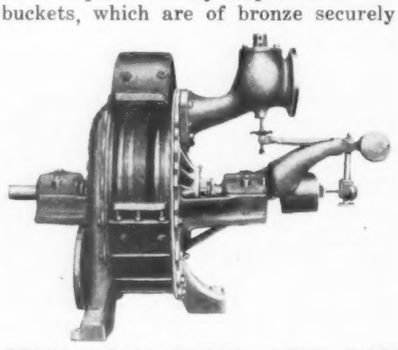


METHOD OF FASTENING METAL PARTS TO INSULATOR

The outer surface of the collar is threaded, and the covering is screwed over this and is jammed in on a cushioning washer. All screws, clamping bolts and nuts are avoided in this construction. There is, therefore, no possibility of any clamping parts loosening and no danger from over-tightening where clamping rings, etc., are employed, it is said. The Philadelphia Electric Supply Company, 132 South Eleventh Street, Philadelphia, is the selling agent for this device.

Curtis Steam Turbine for Fans and Pumps

The General Electric Company, Schenectady, N. Y., has developed a Curtis steam turbine in a wide variety of capacities to drive fans, blowers and pumps for boiler feeding and circulating systems. It is called the type L and is of the impulse type. The number of stages and rows of buckets varies with the capacity. A split wheel casing is used to permit ready inspection of the buckets, which are of bronze securely



CURTIS STEAM TURBINE WITH SPLIT CASING

dovetailed into the rim of the wheel. The exhaust steam is free from oil and is well suited for heating feed water. Speed regulation is close and reliable, it is claimed, and the speed may be changed by hand-wheel adjustment while the turbine is in operation. A constant running speed is maintained by a speed governor mounted directly on the shaft and controlling a double-balance piston valve-type throttle.

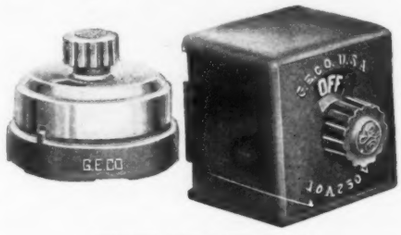
The main shaft carrying the turbine and governor runs on babbitted bearings with renewable linings.

Detachable Wheel Pulley for Automobiles

A pulley designed to fasten to the wheel of an automobile for light power requirements, and which should prove useful to contractors marketing farm-lighting sets, is being manufactured by Max Barash, Maquon, Ill. The pulley can be attached or taken off the wheel in less than four minutes. It is 10.5 in. (26.7 cm.) in diameter and 5 in. (12.7 cm.) on the crown face.

Panelboard Switches

The General Electric Company's panelboard switches are made in both push-button and rotary snap types, with round and square bases for panelboards having either vertical or



ROTARY-TYPE SWITCHES

horizontal mains. They are rated at 10 amp., 250 volts, double-pole. With this new type of panelboard switch the metal parts are entirely inclosed, practically eliminating all danger to the operator. The outside inclosing case is of black composition, smooth and of high finish. They are made in snap and push-button types, as desired. If required, these panelboard switches can be furnished in locking type, operated by a key instead of a push-button.

The rotary type of panelboard switch with the round base is a standard metal-covered snap switch with base slotted for busbars. This can be made to lock by substituting the locking attachment for rotary switches in place of the snap button.

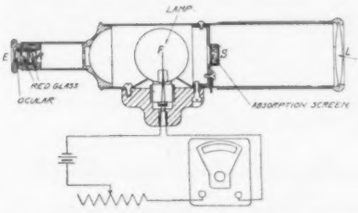
Optical Pyrometer

Portable optical pyrometers, which are based upon the fact that luminous radiation from hot bodies varies in a definite manner as the temperature, have been developed by the Leeds & Northrup Company of Philadelphia, Pa. The instrument is suitable for measuring temperatures from that of a body heated to a dull red color (about 1100 deg. Fahr.—611 deg. C.) up to the highest known temperature, the manufacturer claims.

The manner in which the luminous radiation from a hot body is compared with that from a standardized source will be understood by reference to the accompanying illustration. *L* is a lens by which rays from the hot body at *C* are brought to a focus in the plane *F*, where there is located a tungsten lamp filament. By means of the eyepiece *E* the observer views the incandescent filament, which appears to lie upon the image. By means of rheostat in a case (the case also containing a storage battery and a milliammeter), the current through the lamp is adjusted until the

brightness of the filament is just equal to the brightness of the image produced by the lens, that is, so that the filament blends with, or becomes indistinguishable upon, the background formed by the hot object. The observer then notes the reading of the milliammeter, which may either be provided with a special scale to read in degrees of temperature, or the temperature corresponding to the current may be read from a calibration curve supplied with the instrument.

The adjustment may be made with



DETAILS AND WIRING OF PYROMETER

accuracy and certainty, as the effect of radiation upon the eye varies about twenty times faster than does the temperature at 1300 deg. Fahr. (722 deg. C.), and some fourteen times faster at 3400 deg. Fahr. (1888 deg. C.). Furthermore, the eye is very keen in distinguishing differences in brightness between superposed objects. At high temperatures the light emitted by both the hot body and the filament would become dazzling, and comparison would be difficult. For this reason a red glass is placed in the eyepiece at *R*, which has the further advantage that light of only one color then reaches the eye. The brightness of the image of the hot body produced by the lens *L* is almost absolutely constant, irrespective of the distance from the hot body, although the size of the image varies with the distance.

Placed between the lens and the image is a screen which reduces the light from the hot body, but not that from the filament. With this screen it is possible to make direct observations of the most brilliant light sources, such as the electric arc or the surface of the sun.

The instrument can be calibrated by sighting it upon bodies whose temperatures are known. The instrument is so designed that one lamp can quickly be replaced by another. By keeping two lamps, their correctness can always be insured by checking one against the other. The instrument is handy and portable, weighing only a few ounces, and can be sighted as easily as an opera glass.

Threading Three Sizes of Conduit with One Stock

A pipe-threading die stock that carries three different sizes of dies, each adjusted and ready for use, is one of the new products of the Greenfield Tap & Die Corporation, Greenfield, Mass. The tools are made in sets containing three sizes from ⅛ in. to 1 in. (0.3 cm. to 2.54 cm.). Lost motion, lost parts or lost time, the manufacturer states, are unknown in handling this die stock.

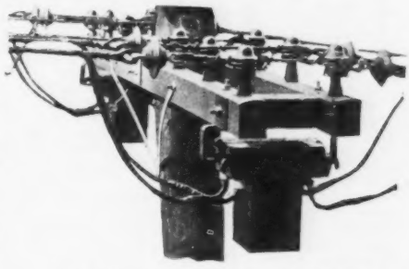
Making Electric Cooking Economical

A small electric range for the use of small families, for apartments, bungalows and summer cottages, has been developed by Landers, Frary & Clark of New Britain, Conn. The device has two heaters. One is a hot plate with two zones of heat, including a small center 3 in. (7.6 cm.) in diameter, for use with small pans, and an outside ring, the complete unit being 8 in. (20.3 cm.) in diameter and consuming 900 watts. The other unit is a 600-watt radiant-grill type, similar to that used in the "Universal" line of grills.

A small portable oven equipped with a heat indicator and capable of holding a 5-lb. (2.26-kg.) roast of meat is supplied, together with two deep steel nickel-plated pans and a reflector plate.

Line-Sectionalizing Breaker

Pole mounting, non-automatic oil circuit breakers have been supplied by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., based upon an idea suggested by the Edison Electric Illuminating Company of Brooklyn, N. Y. Galvanized iron straps are bent and drilled so as to be



METHOD OF MOUNTING BREAKER

attached by one bolt to the cross-arm and by a cover-clamping bolt to the type D non-automatic oil circuit breaker. Longer bolts than standard are used in this latter case. The illustration shows two of these breakers installed on Brooklyn Edison lines, the 4500-volt, two-phase wires being dead-ended on strain insulators tied together and supported by pin insulators.

Automatic Elevator Dispatcher

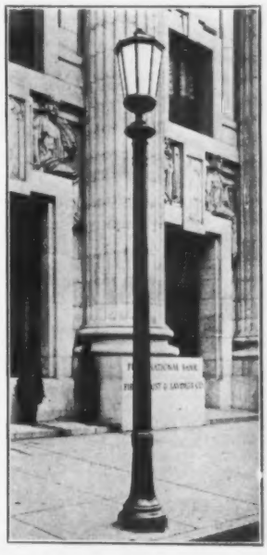
A device for automatically starting elevators from either top or bottom of elevator shaft at predetermined time intervals, each car or bank of cars being confined to its own particular schedule and all cars being controlled from one centralized device, has been brought out by the Building Equipment Company of Chicago, Ill. The results claimed are even distribution of passenger load, reduced cost of operation as result of reduced peak load, better accommodation to passengers because of more room in cars, and more trips made per car. The device consists of a circular plate which is driven by a small motor through reduction gearing at constant speed. Upon this circular plate rest rubber-tired disks. These disks are fastened to shafts upon the end of which are cams having contact brushes. At each revolution of the

DISPATCHER THAT KEEPS ELEVATORS MOVING

cam contact is made and a bell is rung or lamp is illumined as a signal to the elevator driver to start.

Lamp Standards

The lamp standard shown in the accompanying illustration is a product of the Union Metal Manufacturing Company of Canton, Ohio. Six hundred and fifty standards of this design have just been installed in Cleveland. The standards are given a shop coat of green metallastic paint, both inside and outside, before leaving factory, and should have a finishing coat after erection. It is pointed out that all de-



CLEVELAND LAMP STANDARD

signs can be furnished with copper-jacketed shafts at an extra charge. When required, bases are arranged for cut-outs, transformers, etc. Many different designs may be created by interchanging bases, shafts and capitals.

New Incorporations

THE ALVIN (TEX.) LIGHT & ICE COMPANY has been incorporated with a capital stock of $15,000 by C. A. Levens, C. W. Marlin and W. M. Galey.

THE BOWERS (PA.) ELECTRIC COMPANY has been chartered with a capital stock of $5,000 to operate an electric system in Bowers. W. J. Upton is treasurer.

THE GEORGIA PUBLIC SERVICE COMPANY of Tifton, Ga., has been incorporated with a capital stock of $250,000 by C. I. Day, F. G. Whitney and H. R. Roseboro.

THE HONAKER (VA.) LIGHT COMPANY has been incorporated with a capital stock of $5,000. The officers are: C. W. Hurt, president, and G. B. Johnson, secretary.

THE PAUL M. EVANS COMPANY of Philadelphia, Pa., has been incorporated with a capital stock of $25,000 to manufacture and a deal in storage batteries by Sarah H. Evans and others.

THE HENRYETTA (OKLA.) PUBLIC SERVICE COMPANY has been chartered with a capital stock of $200,000 by J. R. Watson, A. W. Anderson and Harlan Reed, all of Okmulgee, Okla.

THE EUREKA (MONT.) HYDRO-ELECTRIC COMPANY has been chartered with a capital stock of $200,000 by J. J. Tetrault of Eureka; C. B. Manwarring and Louis H. Brainwant, both of Whitefish.

THE DEARBORN ELECTRIC CONSTRUCTION COMPANY of Chicago, Ill., has been chartered with a capital stock of $10,000 by Charles S. Knudson, Fred H. Bowen and Leon J. Edelman.

THE NUNN ELECTRIC SIGN SYSTEM, INC., of Oklahoma City, Okla., has been chartered with a capital stock of $5,000 by J. E. Nunn of Amarillo, Tex.; D. W. Mays and W. L. Carloss of Oklahoma City, Okla.

THE SHERIDAN (ILL.) ELECTRIC LIGHT & POWER COMPANY has been incorporated with a capital stock of $3,000 by C. H. Weston, Elmer J. Clark, E. D. R. Robison, A. Christensen and E. S. Erickson.

THE GRAND RIVER ELECTRIC COMPANY of Quapaw, Okla., has been chartered with a capital stock of $3,000 by G. C. Knight of Quapaw, D. F. Butler of Joplin, Mo., and Carl L. Rogers or Oklahoma City, Okla.

THE ANDERSON ELECTRIC CAR COMPANY OF CALIFORNIA of Los Angeles, Cal., has been incorporated with a capital stock of $5,000. The directors are: W. C. Anderson, Fred S. Rogers and T. K. Lemmon.

THE LIGHTING SPECIALTIES COMPANY of Pittsburgh, Pa., has been incorporated with a capital stock of $10,000 by Harold Kirschberg and others. The company proposes to manufacture electric-lighting specialties.

THE GREEN BRIER POWER COMPANY of Ronceverte, W. Va., has been incorporated by J. W. Johnson, of Alderson, W. Va.; W. G. Matthews and A. C. Ford of Clifton Forge, Va. The company is capitalized at $5,000.

THE SANITARY ELECTRIC NOVELTY COMPANY of New York, N. Y., has been chartered with a capital stock of $1,000 to manufacture and deal in electrical devices. The incorporators are: John L. Lyttle, Richard O. Smith and Grace L. Perocheau.

THE STAR ELECTRIC INVESTMENT COMPANY of Newark, N. J., has been incorporated with a capital stock of $100,000 by C. M. Peterson, E. E. Hollander and H. P. Peterson, all of Newark, N. J. The company proposes to deal in electric devices.

THE PULASKI (TENN.) ELECTRIC & WATER COMPANY has been incorporated by C. O. Lindsay, George B. Adams and S. W. Alley, all of Chattanooga, Tenn. The company is capitalized at $50,000 and proposes to operate electric and other local utilities.

THE CAPITAL ELECTRIC LIGHT COMPANY of New York, N. Y., has been incorporated by S. and M. Siegel and S. Eisenberg, 356 Miller Avenue, Brooklyn, N. Y. The company is capitalized at $15,000 and proposes to manufacture gas and electric lamps.

THE NORTHPORT (WASH.) POWER & LIGHT COMPANY has been chartered with a capital stock of $200,000 by Lorne A. Campbell of Rossland, B. C., and others. The company proposes to supply electricity and gas in the State of Washington near Northport.

THE RALPH R. LEWIS COMPANY of Philadelphia, Pa., has been chartered with a capital stock of $25,000 to do a general electrical engineering business. The incorporators are: F. R. Hansell of Philadelphia, Pa.; J. Vernon Pimm and S. C. Seymour of Camden, N. J.

THE CLYMER (N. Y.) POWER CORPORATION has been incorporated by G. H. Tenpas, L. Tenpas and G. W. Tenpas. The company is capitalized at $25,000 and proposes to generate and distribute electricity for transportation, manufacturing, heating and lighting purposes.

THE NUTRY & COOK INTERNATIONAL TRANSMITTER COMPANY of New York, N. Y., has been incorporated by John Nutry, A. S. and W. A. Cook, 15 Jerome Street, Brooklyn, N. Y. The company is capitalized at $5,000 and proposes to manufacture transmitting and telegraphic instruments.

THE SILENT VALVE MOTOR CORPORATION has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $3,500,000 to manufacture motors, engines and mechanical and electrical devices. The incorporators are: W. E. Pearson, E. F. Oates and E. L. Russell, all of New York, N. Y.

THE ELECTRIC AUTO LITE CORPORATION has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $13,000,000 to manufacture, sell and deal in engines, electrical and mechanical devices of all kinds. C. L. Rimlinger, H. L. Mullin, C. M. Egner, local (Wilmington, Del.), incorporators.

THE UNIT VENTILATION COMPANY of Queens, N. Y., has been incorporated to manufacture ventilating devices and to do a general electrical and mechanical engineering business. The incorporators are: A. Bautz of College Point; W. F. Brown, 911 Whitlock Avenue, the Bronx, and J. F. Maguire, 375 Fulton Street, Brooklyn, N. Y.

Trade Notes

B. J. SULLIVAN, who has been associated with the sales department of the Commercial Electrical Supply Company of St. Louis in charge of its service department, has joined the First Missouri Artillery, Battery A, which is to be mustered into federal service shortly.

THE NEVADA CONSOLIDATED COPPER COMPANY has placed an order for electric hoisting equipment for its mine at Ruth, Nev., which calls for a 400-hp. Westinghouse type CW wound-rotor induction motor and complete control equipment, comprising a Westinghouse liquid controller with necessary electromagnetic switches.

H. H. CUDMORE has left the Mazda lamp department of the General Electric Company to engage in the business of distributing the Oscar Sheck Universal Projector Lamp Appliances, distributed by the Argus Lamp & Appliance Company of Cleveland. Mr. Cudmore has been identified with the Mazda lamp industry for over ten years, and prior to that time was engaged in the electrical jobbing business in Cleveland.

THE CHELTON ELECTRIC COMPANY, 314 Armat Street, Philadelphia, Pa., announces that it has recently made arrangements to have Hight & Stout, 143 Liberty Street, New York City, handle its New York account. This firm will furnish samples as well as distribute literature and can quote low prices on the full line of the Chelton company. Mr. Hight was formerly New York representative of the Weber Electric Company, and Mr. Stout was formerly with the Bryant Electric Company.

D. M. BIGGAR, for several years the manager of the foreign exchange department of the American Express Company in Chicago, will sail late in August for Shanghai, where he will establish another office of this company's Far Eastern organization, which had its beginning with the opening of offices in Manila and Hongkong in 1916. He will be followed by R. E. Bergeron, formerly special traffic agent of the Russian division in New York, who will sail on Sept. 15 for Yokohama to open there the fourth Far Eastern office. Mr. Bergeron has only recently returned from making a first-hand investigation of conditions in the Orient and Russia. Each of these new offices will be fully equipped to serve in connection with commercial financing and transportation of merchandise or personal shipments, large or small, via freight or express service. They will investigate opportunities for trade, provide tickets or accommodations for tourists or commercial travelers and extend the field of the American Express travelers' cheque.

THE ATLAS CRUCIBLE STEEL COMPANY has ordered for its Dunkirk (N. Y.) plant a standard rolling-mill drive consisting of a 450-hp. wound-rotor induction motor, a rotary converter and a 130-hp. direct-current motor. This apparatus is so interconnected that at heavy loads the rotor currents supply power through the rotary converter for the direct-current motor, which in turn helps drive the mill. The manufacturer of this outfit, the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has also received from the Brier Hill Steel Company of Niles, Ohio, an order for a 132-in. plate-mill equipment consisting of a 5000-hp. induction motor with primary control panel and step regulator, a 24-in. reversing roughing mill with a 7600-hp. direct-current motor and a 2250-kw., 1500-hp. motor-generator set with 60,000-lb. flywheel, besides an 84-in. plate-mill equipment with a 2500-hp. induction motor, primary control panel and slip regulator. Additional electrical equipment ordered for this plant includes two 750-kw. synchronous motor-generator sets and four 3500-kva. radiator-type transformers.

Trade Publications

FIRE EQUIPMENT.—The New York Brass Foundry Company of 104 Centre Street, New York City, has prepared a booklet on the Monitor detector system.

INSULATION.—The Mitchell-Rand Manufacturing Company, 99 John Street, New York City, is sending out a mailing card containing a few plain tape samples.

ELEVATOR DISPATCHER.—The Buildings Equipment Manufacturing Company, 327 South La Salle Street, Chicago, has prepared a folder descriptive of its line of automatic elevator dispatchers.

LOCOMOTIVES.—Edison storage batteries for use in storage-battery locomotives are described and illustrated in bulletin 608, published by the Edison Storage Battery Company of Orange, N. J.

LUNGMOTOR.—The Life Savings Devices Company, 564 West Monroe Street, Chicago, is mailing out a "hurrygram," announcing a booklet on "Life for the Men in the Trenches."

OIL SWITCH. — The Crocker-Wheeler Company of Ampere, N. J., has prepared bulletin No. 179 descriptive of its alternating-current oil switch for reversing service for two-phase or three-phase work.

ADJUSTABLE LIGHT FIXTURES.—Anderson adjustable light holders and unit systems of lighting are illustrated and described in a bulletin distributed by the Franklin Specialty Manufacturing Company of New York City.

ELECTRICAL SUPPLIES.—M. B. Austin & Company of Chicago are distributing catalog "G," descriptive of "The Austin Line." This catalog includes data on electrical wires and cables, interior conduits, conduit fittings and electrical specialties.

CHAIN DRIVE.—"Some Facts About Chain Roller Chain Drives" is the title of book No. 361, issued by the Link-Belt Company of Chicago, Ill. This company has also prepared book No. 326, descriptive of "T T" class roller chains for tractors and trucks.

CONSTRUCTION WORK.—Ford, Bacon & Davis, engineers, of New York, San Francisco and New Orleans, are distributing a folder descriptive of recent construction work. This bulletin includes information on a double-deck wharf house, pier 41, Galveston Wharf Company, Galveston, Tex.

LOCOMOTIVE PERFORMANCE COSTS.—The Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., has prepared a bulletin entitled "Westinghouse Electrification Data." This book outlines the proper basis for comparing locomotive performance costs. Type "E" oil circuit-breakers for capacities up to 2000 amp. for voltages up to 23,000 are illustrated and described in catalog No. 3001 issued by this company. It has also prepared a catalog on oil-circuit-breaker accessories.

STORAGE BATTERIES.—Bulletin No. 168 is descriptive of the "Exide" battery for marine wireless service and is being distributed by the Electric Storage Battery Company of Philadelphia. This bulletin supersedes bulletin No. 149. This company is also distributing bulletin No. 165, descriptive of twenty-four-hour service for small central stations by means of the "Chloride" accumulator. It is also distributing bulletin No. 166, which relates to storage battery installations for stand-by service in large central lighting and power plants.

New England States

PORTLAND, ME.—The Board of Aldermen has granted the petition of the Cumberland Light & Power Company asking for conduit rights, manholes, etc., on various streets of the city.

WATERBURY, VT.—The installation of a municipal electric-light plant is under consideration.

ATHOL, MASS.—The Athol Gas & Electric Company has secured contracts to supply electricity to operate the mills of the L. S. Starrett Company and the Union Twist Drill Company. Both companies have private electric generating plants, which have been discarded owing to the high price of coal.

BONDSVILLE, MASS. — Work is progressing rapidly on the new power house being erected for the Boston Duck Company.

BROCKTON, MASS. — Application has been made by the W. W. Cross Company for a permit to erect a power house and stack on Montauk Road, to cost about $20,000. Contract has been awarded to George Howard & Sons Company.

NORTH ADAMS, MASS.—The Boston & Maine Railroad Company, through its receiver, James H. Hustis, has filed a petition with the Federal Court for permission to contract with the North Adams (Mass.) Gas Light Company for energy to light the Hoosac tunnel. If the petition is granted this will separate the lighting equipment from that which furnishes power for the electric operation of trains through the tunnel, releasing more power to operate the trains through the tunnel and insuring adequate lighting facilities.

PITTSFIELD, MASS.—The contract for the erection of a power house 60 ft. by 70 ft. at the James & E. H. Wilson plant has been awarded to F. T. Ley & Company of Springfield.

SPRINGFIELD, MASS.—The Standard Electric Time Company is planning to erect an addition to its factory in Logan Street, at a cost of about $25,000. H. V. Paterson is architect.

SPRINGFIELD, MASS. — The Turners Falls (Mass.) Power & Electric Company has petitioned the Massachusetts Waterways Board for permission to cross the Connecticut River at Springfield to supply energy to the Springfield Street Railway Company.

SPRINGFIELD, MASS.—An urgent deficiency appropriation of $445,000 for improvements at the United States Armory and the water-shop plant has been asked by Secretary Baker of the War Department. Of the proceeds, $300,000 would be used for replacing obsolete and worn-out machinery, $90,000 for installing an electric generating plant at the watershops, $25,000 for a new lighting system and $30,000 for a physical and chemical laboratory, including buildings at the Armory.

TURNER'S FALLS, MASS.—The Franklin Electric Light Company has been granted permission to erect electric transmission lines on O and High Streets. The company has also asked for authority to build a transmission line on the Montague road at Montague City in the near future.

WORCESTER, MASS. — The Worcester Electric Light Company is erecting another substation, 53 ft. by 73 ft., on Grafton Street. Energy from the Webster Street generating plant will be transformed at this station. The E. J. Cross Company has contract for construction of building.

WORCESTER, MASS.—The Gas and Electric Light Commissioners have authorized the New England Power Company to issue securities to the amount of $7,000,000, the proceeds to be used for the construction of a dam, power house and reservoir at Readsboro. The proposed dam will be about 200 ft. high and the reservoir is to have a storage capacity of 3,600,000,000 cu. ft. A tunnel will be built 14,000 ft. long from the dam to the power house. The plans provide for a development of about 36,000 hp.

HARTFORD, CONN. — The Hartford Electric Steel Company has secured a contract from the New Britain (Conn.) Machine Company for 1,200,000 lb. of steel castings, to be used in building anti-aircraft gun mounts. The New Britain company will advance the money to double the capacity of the Connecticut company's plant, the advance to be paid out of future profits.

NEW HAVEN, CONN.—A permit has been granted to Yale University for a one-story heating and power plant to be erected at the corner of Ashmun and York Streets. The proposed plant will supply electricity for lighting and heating all of the university buildings. The recently constructed tunnels connecting the college buildings will be used for the wire and pipe lines extending from this station. The cost of the plant complete is estimated at about $160,070.

NEW LONDON, CONN.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Aug. 20 for construction of a reinforced concrete general storehouse, 64 ft. by 224 ft., including electrical work, etc., at the submarine base, New London, Conn. Drawings and specifications (No. 2462) may be obtained on application to the above bureau or to the commanding officer at the submarine base named.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

Middle Atlantic States

BALDWINSVILLE, N. Y.—The Seneca River Power Company has petitioned the Public Service Commission for permission to erect a new electric transmission line at Van Buren.

ROCHESTER, N. Y.—The Public Service Commission has granted the Rochester Railway & Light Company permission to increase its capital stock from $9,500,000 to $10,250,000.

GARWOOD, N. J.—Plans have been prepared for an extension, 40 ft. by 100 ft., one story high, to the plant of the Hall Switch & Signal Company on Centre Street. H. W. Wolff is general superintendent.

PHILLIPSBURG, N. J.—The Phillipsburg Transit Company has applied to the Public Service Commission of the State of Pennsylvania for permission to operate in Easton and vicinity.

PRINCETON, N. J.—The Public Service Electric Company is installing a new underground conduit on Stockton Street, prior to paving the thoroughfare.

CHESTER, PA.—A machine shop, 40 ft. by 70 ft., is being erected at the new electric power station of the Beacon Light Company in Chester, now under construction at a cost of over $2,000,000.

ENOLA, PA.—Work has begun on the construction of the new addition of the power plant in the local yards of the Pennsylvania Railroad. A battery of six out-of-date railroad engines has been equipped to be used while the boilers of the power plant are being overhauled. The output of the plant will be doubled.

HARWOOD, PA.—The Harwood Coal Company is installing a new electrically operated shovel at its local culm banks. Energy will be supplied from the plant of the Harwood Electric Company.

LANSDALE, PA.—Plans are being considered by the North Penn & Buckingham Valley Railways Company for the construction of a new interurban railway connecting Upper North Penn and Buckingham Valley districts, including Quakertown, Dublin, Glen, Almont and Blooming Glen with Doylestown and vicinity, about 24 miles long.

MARCUS HOOK, PA.—The Benzol Products Company is contemplating the erection of a new transformer and switching station, to cost about $10,000, at its local plant.

PHILADELPHIA, PA.—Revised plans are now being prepared for the construction of a one-story power plant at the new institution to be constructed by the St. Vincent's Home on Lansdowne Avenue.

PITTSBURGH, PA.—Permits have been granted the National Biscuit Company for the erection of a seven-story brick and concrete baking factory, a two-story power house and a garage, at Penn Avenue and Lambert Street. The cost of the buildings is estimated at $560,000.

POTTSVILLE, PA.—The Public Service Commission has given its approval of the new system of lighting for Pottsville and also of the new contract for street lighting between the city of Pottsville and the Eastern Pennsylvania Light, Heat & Power Company for a period of ten years. The new system will be installed as soon as possible.

SHARON, PA.—The Borough Council has awarded a contract to the Shenango Valley Electric Light Company for the installation of an ornamental street-lighting system, consisting of 84 ornamental standards, at a cost of about $3,913.

WAYNESBORO, PA.—Negotiations are under way between the Chambersburg, Greencastle & Waynesboro Street Railway Company and the Hagerstown & Frederick Railway Company whereby the electric railway from Pen Mar to Chambersburg (30 miles long) and the electric-light and power plant in Waynesboro may be purchased by the latter.

WILKES-BARRE, PA.—The Lehigh Valley Railroad Company, it is reported, is preparing plans for equipping its line from Penn Haven to Wilkes-Barre, Hazleton and vicinity for electrical operation.

BALTIMORE, MD.—Plans have been prepared by the Baltimore Dry Dock & Shipbuilding Company for the erection of additional buildings, including a power house, 70 ft. by 90 ft., one story high.

BALTIMORE, MD. — The Consolidated Gas, Electric Light & Power Company, it is reported, is planning to increase its electrical department and proposes to organize a company to be known as the Consolidated Power Company and issue $5,000,000 in notes. The plans of the company provide for doubling the electric generating capacity and include the installation of a 50,000-hp. generating plant within the next 18 months.

MARLINTON, W. VA.—The City Council is considering the purchase of the local electric-light plant and water-works system to be owned and operated by the municipality.

WASHINGTON, D.C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Aug. 27 for the construction of six two-story steel-frame buildings, including electric elevators, electric lighting, heating and plumbing, etc., at the following naval depots: Two at Hingham, Mass.; two at Lake Denmark, N. J.; one at Fort Mifflin, Pa., and one at St. Julien's Creek, Va. Drawings and specifications (No. 2427) may be obtained upon application to the bureau or to the commandants of the navy yards, Boston, Mass., New York, N. Y., Philadelphia, Pa., and Norfolk, Va.

North Central States

LAKEVIEW, MICH.—Work has begun on the erection of the electric transmission line from Amble to Lakeview, which will furnish energy here from the new power plant at Morley. Poles have been erected for the line between Lakeview and Edmore.

BELLEVILLE, OHIO.—Right-of-way has been secured by the Ohio Light & Power Company of Mount Vernon for the erection of an electric transmission line from Fredericktown to Belleville. The company will install a lighting system in Belleville.

CANTON, OHIO.—A 7500-kw. synchronous condenser at the Sunnyside plant of the Central Power Company was damaged recently by fire.

CLEVELAND, OHIO. — The Cleveland Electric Illuminating Company has awarded the general contract for the reinforced concrete work in connection with its new power house, 122 ft. by 300 ft., to the Turner Construction Company.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, Ohio, until Aug. 21, for furnishing transformers for the Division of Light and Heat. Specifications may be obtained at the office of the Division of Light and Heat, Room 204, City Hall.

DEFIANCE, OHIO.—The Defiance Gas & Electric Company has secured contracts to supply electricity for lighting the towns of Waterville and Haskins from its hydroelectric plant above Defiance.

SPRINGFIELD, OHIO.—The contract for construction of the addition to the plant of the Springfield Light, Heat & Power Company has been awarded to L. Schreiber & Sons Company of Cincinnati.

YOUNGSTOWN, OHIO.—Arrangements are being made to equip the plant of the Hercules Powder Company, just outside of the city, for electrical operation throughout. The Hercules company has contracted with the Mahoning & Shenango Railway & Light Company to supply 300 hp., which heretofore has been supplied by its own steam generating plant.

SOMERSET, KY.—The Southern Machine Exchange of Somerset is reported to be in the market for a 50-hp., 220-volt, alternating-current motor and a 50-hp. oil engine.

GOSHEN, IND.—The City Council has instructed V. A. Harding, superintendent of the municipal electric-light plant and water-works system, to prepare plans and estimates of cost of the installation of a central heating station. A preliminary estimate places the cost at about $16,797.

CHICAGO, ILL.—The National Electric Lamp Association is reported to have purchased a site on Flourney Street upon which it proposes to erect a factory.

CHICAGO, ILL.—The Belden Manufacturing Company, 2300 South Western Avenue, has awarded the general contract for a one-story factory building, 92 ft. by 127 ft., to be erected on West Van Buren Street. This is the initial building of a proposed plant, to cost about $250,000. The company manufactures insulated wires.

CLINTON, ILL.—Plans have been prepared for the construction of a boiler and engine house, to cost $20,000, and an addition to roundhouse and coal chute, to cost about $38,000, at the yards of the Illinois Central Railroad Company at Clinton. A. S. Baldwin is chief engineer.

ASHLAND, WIS.—Plans are being considered by the Wisconsin Telephone Company for extensions to its local system.

BEAVER DAM, WIS.—The City Council is considering the purchase of the local electric-light plant to be owned and operated by the municipality. If taken over by the city improvements will be made to the system.

MANITOWOC, WIS. — The Wisconsin Public Service Company has been granted permission by the City Council to extend its transmission lines into the city.

MODOVI, WIS.—Joseph Wulff, local machinist and blacksmith, is contemplating enlarging his shop and installing a new electric motor and a number of machine tools.

RACINE, WIS.—The Wisconsin Gas & Electric Company has increased its capital stock from $2,750,000 to $3,350,000, the proceeds to be used for extensions to its electric plant and transmission system at Racine and throughout southern Wisconsin. S. B. Way of Milwaukee, vice-president, is in charge.

CEDAR RAPIDS, IOWA. — The Iowa Electric Company of Cedar Rapids has been granted a franchise by the Board of Railroad Commissioners to erect and operate electric transmission lines upon certain roads and highways in Johnson and Washington Counties for a period of 25 years.

CENTERVILLE, IOWA.—The Board of Railroad Commissioners has granted the Iowa Southern Utilities Company of Centerville a franchise to erect and operate electric transmission lines over certain roads and highways in Wayne, Decatur and Ringgold Counties for a period of 25 years.

EDDYVILLE, IOWA.—The Albia Interurban Railway Company is reported to have secured contracts to supply energy to the mines of the Rex Fuel Company and the Maple Coal Company, which will be equipped with electrically operated machinery.

MAXWELL, IOWA.—The Mid-West Electric Company has been awarded contract to erect a high-tension transmission line from Maxwell to Collins and also a substation in Collins.

TRENTON, MO.—The Chicago, Rock Island & Pacific Railway Company is planning to erect a coaling station at Trenton and install mechanical loading apparatus. C. A. Morse of Chicago, Ill., chief engineer, is in charge of the work.

JAMESTOWN, N. D.—The local plant of the Western Electric Company is reported to have been destroyed by fire.

AVOCA, NEB.—Bonds to the amount of $5,000 have been voted for the installation of an electric-lighting system in Avoca.

LINCOLN, NEB.—Plans are being prepared for the construction of a boiler house at the State Penitentiary, to cost about $15,000. J. W. Salmon, Orpheum Building, Lincoln, is architect. Leo Matthews is secretary of state board of control.

YORK, NEB.—The Council has passed an ordinance providing for improvements to the electric-lighting system. The plans, it is understood, provide for 235 street lamps.

ABILENE, KAN.—The Riverside Light & Power Company is erecting a reinforced concrete oil tank of 25,000 barrels capacity. The oil will be used for fuel in its steam-driven electric plant.

CAPRON, KAN.—The installation of an electric-lighting plant in Capron is under consideration. An electric transmission line will be erected to connect with the Kiowa-Hardtner transmission line to secure energy to operate the system.

LURAY, KAN.—Bonds to the amount of $20,000 have been voted for the installation of a municipal electric-light plant.

Southern States

BADIN, N. C.—Plans are being considered by the Aluminum Company of America, Oliver Building, Pittsburgh, Pa., for the construction of a second dam at the Yadkin Falls site, below its Narrows Dam plant. The power house will be equipped with three 10,000-hp. units. The proposed new plant will be used as an auxiliary to the present plant during the low water periods. James W. Rickey of Pittsburgh, Pa., is hydraulic engineer.

MAXTON, N. C.—Bids will be received by the Town Commissioners for the construction of an electric-lighting system. C. B. Thompson is clerk and treasurer.

GREENVILLE, S. C.—The contract for the electrical system for Camp Sevier has been awarded to Huntington & Guerry of Greenville. More than 1,000,000 ft. of wire will be required.

PORT ROYAL, S. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Aug. 20 for construction of two officers' quarters, including electric lighting, plumbing, etc., at the Marine Recruiting Station at Port Royal, S. C. Drawings and specifications (No. 2499) can be obtained on application to the bureau or to the commandant of the naval station named.

SPARTANBURG, S. C.—Huntington & Guerry of Greenville have been awarded the contract for furnishing and installing electrical equipment at Camp Wadsworth for which more than 1,000,000 ft. of wire will be required.

ATLANTA, GA.—The Georgia Railway & Power Company has petitioned the State Railroad Commission for permission to issue $2,500,000 in bonds, the proceeds to be used for the installation of the sixth unit in the Tallulah Falls power station, the construction of a new reservoir on the Tallulah River, above Rabun Lake, to be known as the Burton reservoir, and the construction of a new power station, 2 miles below the Tallulah Falls plant, near the junction of the Tallulah and Chattooga Rivers, at the point where they form the Tuglo River.

LEESBURG, FLA.—The City Council is considering calling an election to submit the proposal to issue $40,000 for the installation of an electric-light plant and waterworks system to the voters.

CLARKSVILLE, TENN.—Steps have been taken by the Young Men's Club to secure the installation of an ornamental street-lighting system in the downtown section of the city. The cost is estimated at $5,000.

KNOXVILLE, TENN.—The New Imperial Realty Company has awarded contract to the E. W. Minter Company, 115 Broadway, New York, N. Y., to erect the Hotel Farragut. The main building will be 75 ft. by 123 ft., nine stories high, and will cost about $350,000; heating system, $47,000; electric lighting, $15,000; elevators, $15,000; and plumbing, $56,000. The contract for electrical equipment and plumbing has been awarded to Engert Vance Company of Knoxville. W. L. Stoddart, 9 East Fortieth Street, New York, N. Y., is architect.

BATESVILLE, ARK.—Contract has been awarded by the City Commissioners for improvements to the water and light plant, including the installation of a new engine and generator, etc., to the P-K Engineers, 915 Olive Street, St. Louis, Mo. Bids will be opened on Aug. 14 for filter building, wells, etc. Frank L. Wilcox, Syndicate Trust Building, St. Louis, Mo., is engineer.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company has erected a high-tension transmission line to Huntington to supply electricity to the Coal District Power Company. The Fort Smith company has also ordered material for an extension of its transmission lines to supply the Citizens' Electric Company with energy. The latter company supplies electrical service in Alma, Mulberry and Ozark. The contract with the Coal District company calls for 1000 hp. The Fort Smith company will increase the output of its power station to meet the additional demands for service.

JONESVILLE, LA.—The Jonesville Lumber & Veneer Company is considering the purchase of equipment for power plant, including boilers, two engines, etc. A. W. Stewart is president.

COMANCHE, OKLA. — The Consumers Light & Power Company has submitted a proposal to the City Council offering to purchase the municipal light plant and water-works system.

OKLAHOMA CITY, OKLA —The Traders' Oil & Refining Company, Baltimore Building, is reported to be in the market for the purchase of equipment for an oil-refining plant, including boiler, steam still, tanks, pumps, etc.

STILLWATER, OKLA.—Bonds to the amount of $6,000 have been voted, the proceeds to be used for the installation of a boiler in the municipal light and water plant.

CISCO, TEX.—Improvements are contemplated to the plant of the Cisco Gas & Electric Company, including the installation of a new boiler, lightning arresters, etc.

EL PASO, TEX.—It is announced by J. M. Lawson, manager of the Elephant Butte Reclamation project, that the United States government will make a thorough investigation as to the advisability of installing a hydroelectric plant at the dam which was completed across the Rio Grande at a point in New Mexico, above El Paso, several months ago. It is roughly estimated that the cost of the proposed plant would be about $1,000,000. The government does not propose to provide this money, but the funds are to be furnished by the Water Users' Association, which owns the land embraced in the large irrigation enterprise. It is estimated that 40,000 hp. could be developed.

SAN ANGELO, TEX.—The power of the electric transmission line extending between San Angelo and Winters, a distance of 75 miles, it is reported, will be doubled. This will be done in time to supply electricity to operate the cotton gins this fall.

VICTORIA, TEX.—The City Council has adopted a resolution providing for engaging an electrical engineer to prepare plans for the installation of a municipal electric-light plant. This action was taken expressly for the purpose of laying a municipal service wire conduit underground and installing the equipment for an ornamental lighting system before the streets are paved. Bonds to the amount of $40,000 were voted for the installation of a municipal plant more than two years ago. The delay in the sale of the bonds was due to a reduction in the street-lighting charges and other concessions made by the Texas Gas & Electric Company.

Pacific and Mountain States

BREMERTON, WASH.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Aug. 20 for construction of a torpedo storehouse, including overhead trolley track and electric hoists, at the naval torpedo station, Keyport, Puget Sound, Wash. Drawings and specifications (No. 2483) may be obtained on application to the bureau or to the commandant of the navy yard, Puget Sound.

CENTRALIA, WASH. — The Thomas Paper & Pulp Company, recently organized, has purchased 300 acres of coal land to furnish fuel for its power plant to be erected in Centralia. The company proposes to build a large paper mill in Aberdeen to manufacture paper from red fir by a new process.

EDMUNDS, WASH.—The City Council has accepted the proposal of the Washington Coast Utilities Company of Arlington to furnish electricity for lighting the city. On account of financial conditions the lighting system was discontinued two years ago. The street-lighting system will consist of 17 lamps of 60 cp. and 16 of 100 cp.

PORT ANGELES, WASH.—At an election held July 20 the proposal to issue $30,000 for extensions and improvements to the municipal electric-lighting system was defeated.

SEATTLE, WASH.—Extensions to the municipal street railway lines, involving an expenditure of about $500,000, have been authorized by the City Council.

SEATTLE, WASH.—The Seattle Construction & Drydock Company is planning to build a one-story addition, 16 ft. by 50 ft., to its power plant at 901 Railroad Avenue South.

SEATTLE, WASH.—A site covering an entire block of waterfront property has been secured by the Gray & Barash Company on which it will erect a plant for manufacturing electrical and nautical machinery.

SEATTLE, WASH.—Bids will be received by Reuben W. Jones, secretary of board of directors of the Seattle school district No. 1, until Aug. 17 for electric-lighting fixtures for the West Seattle High School in accordance with plans prepared by Edgar Blair, school architect.

SEATTLE, WASH. — The Kilbourne & Clark Manufacturing Company, manufacturers of wireless apparatus, has purchased a two-story, 180 ft. by 120 ft., concrete building on Railroad Avenue and Connecticut Street, and is remodeling same. Two extensions are being built at the main structure and a system of skylights installed. The plant will be operated throughout by electricity.

SEATTLE, WASH.—Contracts will soon be awarded for the construction of the first unit of the new manufacturing plant of Gray & Barash, manufacturers of electrical machinery, to be located on the Canal Waterway. The plans provide for the erection of one frame building, 75 ft. by 120 ft., and one of concrete, 40 ft. by 100 ft., to cost $20,000 and $25,000 respectively. The company now has a plant at 316 First Avenue South.

SEDRO-WOOLLEY, WASH.—Bids will be received by the State Board of Control, Olympia, Wash., until Aug. 13 for construction of power house and stack at the Northern State Hospital, near Sedro-Woolley. Bids will also be received at the same time for furnishing and installing one water-tube boiler, with necessary steam, water, smoke and other connection and two new stokers, one for the new boiler and the other for the boiler now in use. George W. Lawton, Alaska Building, Seattle, is architect.

TACOMA, WASH.—The Puget Sound Traction, Light & Power Company has petitioned the Commissioners of Pierce County for a franchise to construct and operate an electric transmission line over and along certain roads and highways in Pierce County for a period of 25 years.

TACOMA, WASH.—The City Council is considering a proposal to furnish the Chicago, Milwaukee & St. Paul Railway Company energy to the amount of 2000 kw. daily. This is the amount, it is estimated, that the railroad will require within the city limits when it has completed changing its railway through the State from steam to electrical operation.

VANCOUVER, WASH.—Plans are being considered by the National Home Building Company to double the output of its plant and install new machinery, equipped with individual motors. The company manufactures knockdown houses and boxes.

BAKER, ORE.—The Allis-Chalmers Company has secured the contract for furnishing machinery for an electrically driven sawmill for the Oregon Lumber Company at Baker. The power plant will be equipped with a 625-kva. Allis-Chalmers steam turbine unit.

BAKER, ORE.—The power plant of the Eastern Oregon Light & Power Company at Olive Lake, near Baker, was recently damaged by fire. At present Baker and a number of small cities in this section are without lighting service. Fire caused the headgates to open, flooding the plant.

GRANTS PASS, ORE.—The contract for furnishing electric-lighting fixtures for the Grants Pass court house has been awarded to M. J. Walsh of Portland, at $4,678.

MYRTLE CREEK, ORE.—The proposed charter for the town of Myrtle Creek permitting the Council to issue bonds not exceeding $30,000 for the installation of an electric power plant and improvements to the water-works system was adopted by the voters at a recent election.

PORTLAND, ORE.—The contract for electric wiring in the Woodstock School in Portland has been awarded to Miller & Halls, electrical contractors, of Portland.

PORTLAND, ORE.—Plans have been completed for the erection of bunkers and the installation of coal-handling machinery at the Port of Portland and also for the construction of a number of ocean-going barges with a capacity of 8000 tons each.

SALEM, ORE.—The contract for wiring the new Oregon Agricultural College Library has been awarded to the Salem Electric Company.

CHICO, CAL.—Steps have been taken by the Board of Trustees to secure an improved street-lighting system in Chico.

FRESNO, CAL.—Preparations are being made by the San Joaquin Light & Power Corporation to extend its electric transmission lines into new territory from Chowchilla for a distance of about 20 miles, which will take in the block of 42,000 acres of land recently purchased by the Chowchilla Lands Company of the United States Land Company, and the large ranch, 44,000 acres, owned by Bliss Brothers.

GRASS VALLEY, CAL.—Extensive improvements are contemplated for the Wisconsin gravel mine and new machinery has been ordered. An electric hoist will be installed, together with rotary blower and other equipment. The electric plant will be installed in the main tunnel.

HANFORD CAL.—The installation of a new street-lighting system in Hanford is under consideration. It is proposed to substitute electroliers for the arc lamps now in use in the business district and erect new lamps throughout the residential section of the city.

LA GRANGE, CAL.—The Sierra & San Francisco Power Company of San Francisco and the Yosemite Power Company of La Grange have applied to the State Railroad Commission for permission for the latter to sell to the former all its property in its La Grange division for $450,000.

LA HABRA, CAL.—The residents of La Habra have petitioned the Board of Supervisors for permission to establish an electric-lighting system here.

LIVINGSTON, CAL.—A petition is being circulated by the Livingston Board of Trade asking the Supervisors to call a special election to vote on the proposition of the formation of a lighting district, to take in all of the town sites.

LOS ANGELES, CAL.—The City Power Bureau is considering beginning work soon on the construction of a power plant on the Franklin canyon line of the Los Angeles aqueduct.

LOS ANGELES, CAL.—A petition for the establishment of a highway lighting district, to be known as the Stephenson Avenue and Laguna Lighting District, has been filed with the Board of Supervisors.

LOS ANGELES, CAL.—Preparations are being made to install an auxiliary power plant in the San Francisquito Canyon, to be ready for service in a few months. The Westinghouse Electric & Manufacturing Company has been awarded contract for generator, transformers and other equipment, at $31,735.

LOS ANGELES, CAL.—The State Railroad Commission has granted the Southern California Edison Company permission to issue $10,000,000 in two years bonds, of which the proceeds of $3,000,000 will be used for the construction of its Big Creek hydroelectric plant and electric transmission line to Los Angeles. The remainder will be used to take up outstanding obligations.

LOS ANGELES, CAL.—Plans are being considered for supplying electricity from the municipal electric power plant to the Los Angeles Shipbuilding & Drydock Company's works at the harbor. The municipal power lines to the harbor are completed and as soon as the aqueduct breaks are repaired the power plant will be able to furnish 1000 hp. of electrical energy to the shipyard.

OROVILLE, CAL.—The Board of Trustees of the city of Oroville has filed a petition with the State Railroad Commission wherein it requests the commission to determine the compensation to be paid the Pacific Gas & Electric Company and the Oro Electric Corporation for their gas and electric plants and distributing systems located in Oroville and an addition known as Oro Vista. The city proposes to purchase the plants rather than to construct a competing system.

SAN DIEGO, CAL.—Application has been filed with the Board of Supervisors for the formation of a public highway lighting district in Normal Heights.

SAN FRANCISCO, CAL.—The State Railroad Commission has granted the Great Western Power Company authority to construct and operate electric transmission and distribution lines throughout Plumas County except in territory reserved for the Grizzly Electric Company, the Quincy Electric Light & Power Company and the Plumas Light & Power Company. The Great Western Power Company is erecting a 50-mile, 44,000-volt transmission line from its Las Plumas plant to Crescent mills at a cost of about $154,000.

SANTA CRUZ, CAL.—The power plant of the Coast Counties Gas & Electric Company at Big Creek, it is reported, was recently destroyed by fire.

TURLOCK, CAL.—Application has been made to the State Railroad Commission for approval of the sale of the Yosemite Power Company, which operates in and around Turlock, to the Sierra & San Francisco Power Company, a subsidiary of the California Railway & Power Company of San Francisco. The Yosemite company has a right of 300 second-ft. of water from the Tuolumne River. The price is said to be $450,000.

VALLEJO, CAL.—Plans are being prepared for the erection of a new plant for the Santa Rosa-Vallejo Tanning Company on the site of the factory that was burned down at North Vallejo. It is proposed to erect a large drying house, a large mill and a small brick or concrete building for power plant. All steam-driven machinery will be replaced with electric motors in the new tannery.

MACKAY, IDAHO.—Contract has been awarded by the Empire Copper Company for the construction of an aerial tramway, 16,300 ft., to cost about $80,000, to the American Steel & Wire Company.

MURRAY, IDAHO.—The Washington Water Power Company of Spokane, Wash., is erecting an electric transmission line into the Murray district to supply energy for dredging operations on North Fork. The transmission line will cross the property of the Giant Ledge Mining Company and will supply electricity to operate the 150-ton mill now under construction on the Giant Ledge.

AJO, ARIZ.—Application has been made to the Board of Supervisors by the Ajo Improvement Club for a franchise to supply electricity, telephone, water, gas and sewer service for domestic and commercial use to the townsite of Ajo.

WILLIAMS, ARIZ.—The City Council is considering issuing bonds for rebuilding the water and light plant, which was recently destroyed by fire.

YUMA, ARIZ.—The Arizona State Corporation Commission has refused to grant the application of Messrs. Sanguinetti & Uwing of Yuma for permission to install a duplicate electric-light and power system in this city. Electrical service is now furnished by the Yuma Light, Gas & Water Company, which secures energy from a California hydroelectric transmission system.

GREAT FALLS, MONT.—The City Council has awarded contracts for the installation of equipment for two ornamental lighting districts: One to the Great Falls Electric Supply Company, at $6,730, and the other to the Electric Supply & Engineering Company of Great Falls, for $7,129.

MALTA, MONT.—The Malta Light Company, recently incorporated, it is reported, contemplates installing an electric-lighting system in Malta. George W. Kemper is interested.

RONAN, MONT.—The City Council has granted Walter G. Griffin of Kalispell a franchise to install and operate an electric-light and power plant in Ronan.

BATTLE MOUNTAIN, NEV.—The Nevada Valleys Power Company of Lovelocks, which was recently granted a franchise to operate in Lander County, has acquired the local plant. The company proposes to enlarge the plant and transmit energy to Copper Canyon, Copper Basin and other points to operate mines and mills in these districts. The erection of a transmission line as far south as Austin is also under consideration.

HORNSILVER, NEV.—The construction of a modern cyanide plant at the Great Western Mine is under way. All machinery, including crusher, ball mill, tube mills, conveyors, pumps, etc. will be operated by electric motors. The power plant will be equipped with a generator driven by a 200-hp. semi-Diesel oil engine. M. R. Thurston consulting engineer, has charge of the work.

LOVELOCK, NEV.—The Nevada Valleys Power Company is planning to extend its electric transmission lines in Storey and Lyon counties to connect with the power plant under construction on the Truckee River at Ditho.

Canada

HARTNEY, MAN.—Tenders will be received until Aug. 13 for electric meters, transformers, wire, generators, switchboard and oil engine. Plans and specifications are on file at the office of the Public Utilities Commission, 300 Tribune Building, Winnipeg.

BRUSSELS, ONT.—The plant of the Brussels Electric Light Company, it is reported, will be sold at auction on Aug. 14.

MOOREFIELD, ONT.—The ratepayers have voted to make connection with the Hydro-Electric system at Palmerston.

ST. CATHARINES, ONT.—The Packard Electric Company of St. Catharines is reported to be in the market for a power squaring shear to cut No. 10 gage steel up to 24 in. wide.

TORONTO, ONT.—The John Inglis Company, 14 Strachan Avenue, is contemplating the construction of a power house, to cost about $5,000.

TORONTO, ONT.—H. W. Petrie of Toronto is reported to be in the market for the purchase of motors, 60 cycles, three-phase, 550 volts, in sizes up to 75 hp.; also an electric generating unit consisting of a 50-hp. or 60-hp. high-speed engine, directly connected to a 110-volt generator.

WINDSOR, ONT.—The Maloney Electric Company is building an addition to its plant, at a cost of about $12,000. William Kerr is manager.

COOKSHIRE, QUE.—The general contract for the construction of a concrete dam for the Westbury Electric Light & Power Company has been awarded to A. Bromwell.

GREENFIELD PARK, QUE.—The contract for the erection of a transformer station has been awarded by the Municipal Council to G. M. Gest, 83 Craig Street W., Montreal.

JOLIETTE, QUE.—The purchase of electrical equipment for the municipal electric-light plant is under consideration. Alfred L. Marsolais is secretary and treasurer.

SWIFT CURRENT, SASK.—The City Council has adopted the recommendation of Engineer Calder for the purchase of a 75-hp. auxiliary induction motor, at a cost of $2,000, and also repair parts for pumps, etc.

Miscellaneous

PANAMA.—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Aug. 24 for wire lathe copper screening, brass tubing, electric cable, cable hangers, motor-driven wood-working machine, motor driven band saw, combination chemical engine and hose cart, tackle blocks, etc. Blanks and further information relating to this circular (No. 1159) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; Audubon Building, New Orleans, La., and Fort Mason, San Francisco, Cal.

KUAHUA, HAWAII.—Bids will be received at the Naval Station, Pearl Harbor, Hawaii, until Sept. 3, for construction of one mine storage building, including steel track and crane, electrical work, etc., at the naval ammunition depot, Kuahua, Hawaii. Drawings and specifications (No. 2489) can be obtained on application to the above bureau or to the commandant of the naval station, Pearl Harbor, Hawaii.

Record of Electrical Patents

Notes on United States Patents issued on July 24 and 31, 1917

1,234,149. ELECTRIC UNIT; Frederick M. Furber, Revere, Mass. App. filed March 27, 1917. Particularly for use in shoe machinery.

1,234,151. MOTOR CONTROLLER; Maurice M. Goldenstein, Milwaukee, Wis. App. filed May 17, 1915. Applicable to motor-driven printing presses.

1,234,196. HEATING-COIL DISK; Morton Murphy, Janesville, Wis. App. filed April 15, 1916. Means for supporting the heating coil within the bottom of the receptacle.

1,234,205. STRAIN INSULATOR; David H. Osborne, Victor, N. Y. App. filed April 15, 1916. Method of connecting the insulating or porcelain section with a strain member.

1,234,271. OUTLET BOX FOR ELECTRIC CONDUITS; William A. Bonnell, Brooklyn, N. Y. App. filed July 8, 1915. Means for holding so-called "knock-outs" in position in the conduit-receiving sockets or apertures in the boxes when the same are not in use.

1,234,280. ELECTRIC HEATING DEVICE; Francis C. E. Burnett and Ernest J. Brunning, Montreal, Quebec, Canada. App. filed Nov. 27, 1916. Improvements.

1,234,313. INSULATOR; Anthony F. Efrig, Perkasie, Pa. App. filed May 4, 1915. Without the use of binding wires, plates, etc.

1,234,412. PUSH-BUTTON SWITCH; Alexander K. Sutherland, New Britain, Conn. App. filed Aug. 3, 1916. Flush-type wall switch.

1,234,439. RECTIFIER; Donald M. Bliss, West Orange, N. J. App. filed Sept. 27, 1910. Sparking is minimized.

1,234,464. ELECTRICAL INSTRUMENT; Chester I. Hall, Fort Wayne, Ind. App. filed June 23, 1914. Demand indicator.

1,234,465. ELECTRIC MOTOR; Chester I. Hall, Fort Wayne, Ind. App. filed Dec. 5, 1914. Adapted to be used as timekeeping devices.

1,234,466. MOTOR DEVICE OF THE INDUCTION TYPE; Chester I. Hall, Fort Wayne, Ind. App. filed June 6, 1916. Operation is substantially independent of ordinary voltage fluctuations.

1,234,489. PROCESS TO INCREASE THE SENSIBILITY OF RELAYS FOR ALTERNATING CURRENTS; Eugen Reisz, Berlin-Treptow, Germany. App. filed April 9, 1913. Can only be employed when the relay has no mechanical inertia at all, as is the case, for instance, in gas-discharging relays.

1,234,500. REGULATOR; Allen M. Smith, Fort Snelling, Minn. App. filed July 23, 1915. For opening and closing the draft doors of stoves or furnaces.

1,234,534. ELECTRIC CIRCUIT CONTROLLING DEVICE; John Friis, Chicago, Ill. App. filed Nov. 2, 1914. Flashers.

1,234,542. FEED-THROUGH SWITCH; George H. Hart, West Hartford, Conn. App. filed June 17, 1916. Two base members inclosing a suitable quick-acting switch mechanism, with a simple and effective means for holding said base members together.

1,234,544. FUSE BLOCK; Duncan C. Hooker, Farmington, Conn. App. filed July 1, 1916. Improvement.

1,234,583. SUPPORTING LENGTHS OF WIRE; George V. Twiss, London, England. App. filed Oct. 24, 1916. Support is formed with a passage and segmental undercut recesses on opposite faces of the passage, the wire being retained by a clamp one element of which is provided with flanges adapted to engage in the segmental recesses.

1,234,584. SYNCHRONISM INDICATOR; Gerardus J. Van Swaay, Delft, and Henri I. Keus, Hengelo, Netherlands. App. filed March 16, 1915. Comprises a well-known movable element, such as a disk, subjected to the action of magnetic fields.

1,234,670. ELECTRIC HEATING ELEMENT; George B. Jones, Kokomo, Ind. App. filed Sept. 30, 1915. Supporting means for the exposed resistance coils.

1,234,673. ELECTRIC SPOT-WELDING APPARATUS; Laurence S. Lachman, New York, N. Y. App. filed Jan. 19, 1916. Improvements.

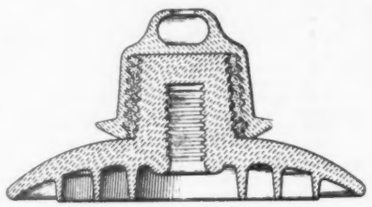
1,234,678. ELECTRIC SWITCH; James F. Lincoln, East Cleveland, Ohio. App. filed Sept. 4, 1915. For retarding the movement of a hand-operated electric switch.

1,234,749. PUSH-BUTTON SWITCH; Frederic P. Gates, Hartford, Conn. App. filed May 21, 1915. Quick-make and quick-break type.

1,234,799. CAPPED CARBON PENCIL; Johann G. Peterson, Jersey City, N. J. App. filed Oct. 25, 1916. Securing a better electrical connection between the cap and the pencil than is at the present time possible.

1,234,840. BINDING POST; Edward F. Weston, Elizabeth, N. J. App. filed Feb. 20, 1917. Head may be removed for inspection.

1,234,857. ELECTRICAL CONNECTION AND BOX; Carl H. Bissell and John J. Dossert, Syracuse, N. Y. App. filed July 27, 1914. Having terminals on its upper face and a closure for the open side of the box having holes aligned with the terminals of the connection.



1,233,296—High-Tension Insulator

1,234,865. ELECTRICAL REGULATOR; Harold W. Brown, Ithaca, N. Y. App. filed Jan. 7, 1914. Based upon the principle that there must necessarily be a time lag after the regulator acts before the machine or circuit is regulated.

1,234,914. DYNAMO-ELECTRIC MACHINE; Marius Latour, Paris, France. App. filed Nov. 25, 1916. High-frequency homopolar machine.

1,234,964. ELECTRICAL MEASURING INSTRUMENT; Harold B. Taylor, Wilkinsburg, Pa. App. filed Aug. 11, 1913. Maximum-demand meters.

1,234,970. INDICATING CYCLE METER; Victor H. Todd, Orange, N. J. App. filed Oct. 6, 1914. Pair of magnets oscillate an armature that releases an escapement wheel which transmits its motion to the hand for indicating the number of cycles of an alternating current that have passed in a certain period.

1,234,973. ELECTRICAL HEATING APPARATUS AND PROCESS OF MAKING THE SAME; Samuel Trood, Wilkinsburg, Pa. App. filed Jan. 7, 1914. Improvements.

1,234,976. ELECTRICAL MEASURING INSTRUMENT; Thomas W. Varley, Pittsburgh, Pa. App. filed Oct. 3, 1913. Watt-hour meters.

1,234,985. CASE FOR INCANDESCENT ELECTRIC LAMP SOCKETS; John Weber, Schenectady, N. Y. App. filed Sept. 3, 1912. Improvements.

1,234,991. ELECTRICALLY HEATED COOKING STOVE; Clifford W. Winterbotham, Brighton Beach, Victoria, Australia. App. filed May 9, 1917. Heat leakage through the cooking chamber insulation is absorbed in a jacket and utilized for warming or heating water.

1,234,999. SWITCHING DEVICE; Walter M. Austin, Swissvale, Pa. App. filed May 28, 1913. Double-throw type.

1,235,028. FIRE-DETECTING WIRE; Charles A. Harsch, New York, N. Y. App. filed Dec. 27, 1916. Steel tape.

1,235,033. RELAY; Henry D. James, Wilkinsburg, Pa. App. filed June 9, 1914. Field magnet relays employed to protect dynamo-electric machines.

1,235,063. ELECTRO-OSMOTIC PROCESS OF TREATING LIQUID MIXTURES; Botho Schwerin, Frankfort-on-the-Main, Germany. App. filed Feb. 16, 1915. Permits a separation from each other of suspension colloids, the so-called true colloids, actually dissolved bodies and electrolytically dissociated ions.

1,235,069. MULTIPLE SERVICE CONNECTION; John T. Skinner, Lawrence, Kan. App. filed Sept. 21, 1914. Improvements.

1,235,081. REACTANCE COIL; Philip Torchio and Harry R. Woodrow, New York, N. Y. App. filed March 15, 1917. For high-tension voltage.

1,235,106. INSULATOR ATTACHMENT; Adelbert C. Burnett, Youngstown, Ohio. App. filed Jan. 24, 1917. Method of securing high-tension wires to the insulator in such manner that the wire may be detached from the insulator, for the purpose of renewing the insulator.

1,235,132. ELECTRICAL MOTIVE APPARATUS; Robert H. Gaylord, Pasadena, and Guy B. Capps, Los Angeles, Cal. App. filed July 23, 1914. For operation of elevators or hoists.

1,235,149. STAMP MILL; Charles M. Mullen and Ray E. Hall, Portland, Ore. App. filed Dec. 1, 1911. Electromagnet or solenoid with which to accomplish successive lifts, thereby greatly simplifying the mechanism necessary.

1,235,162. ENGINE-STARTING MOTOR; Samuel W. Rushmore, Plainfield, N. J. App. filed Sept. 27, 1912. For internal-combustion engines.

1,235,202. PROCESS FOR PURIFYING SALT BRINE; Bruce E. Hartsuch, East Lansing, Mich. App. filed April 26, 1916. Improvements.

1,235,203. ELECTRIC WATER HEATER; Alfred Herz and Charles Herbst, Chicago, Ill. App. filed Aug. 21, 1915. Improvements.

1,235,234. ELECTRIC BELL AND BUZZER; Henry G. Osborne, Brooklyn, N. Y. App. filed Sept. 18, 1916. Improvements.

1,235,271. MULTIPLE-ARC LAMP; Maurice J. Wohl, Brooklyn, N. Y. App. filed April 18, 1916. Improved construction.

1,235,272. ARC LAMP AND REFLECTOR; Maurice J. Wohl, Brooklyn, N. Y. App. filed April 18, 1916. Keeps the arc chamber at a distance from the operating mechanism and prevent injury to the latter by the excessive heat from the arc.

1,235,366. SPRING CONTROL FOR ELECTRICAL MEASURING INSTRUMENTS; Edward P. Noyes, Fort Monroe, Va. App. filed Oct. 18, 1915. Means of counterbalancing the moving parts.

1,235,373. PROTECTION OF ELECTRICAL APPARATUS; Frank W. Peek, Jr., Schenectady, N. Y. App. filed Nov. 30, 1914. Uses alternate layers of an energy-absorbing material and a good dielectric, preferably disposed between the various conducting portions thereof.

1,235,397. ELECTRIC FITTING; George B. Thomas, Bridgeport, Conn. App. filed Feb. 7, 1917. Combined switch and outlet device.

1,235,436. REGULATOR FOR PHASE BALANCERS; Robert M. Carothers, Schenectady, N. Y. May be automatically controlled so as to maintain equality of voltages or currents in the phases of the system.

1,235,524. ELECTRIC WELDING MACHINE; Robert C. Pierce, Cincinnati, Ohio. App. filed Jan. 8, 1917. Improved.

1,235,531. LAMP-SOCKET CASING OR THE LIKE; Charles J. Klein, Milwaukee, Wis. Interlocking means for the sections of such casings.